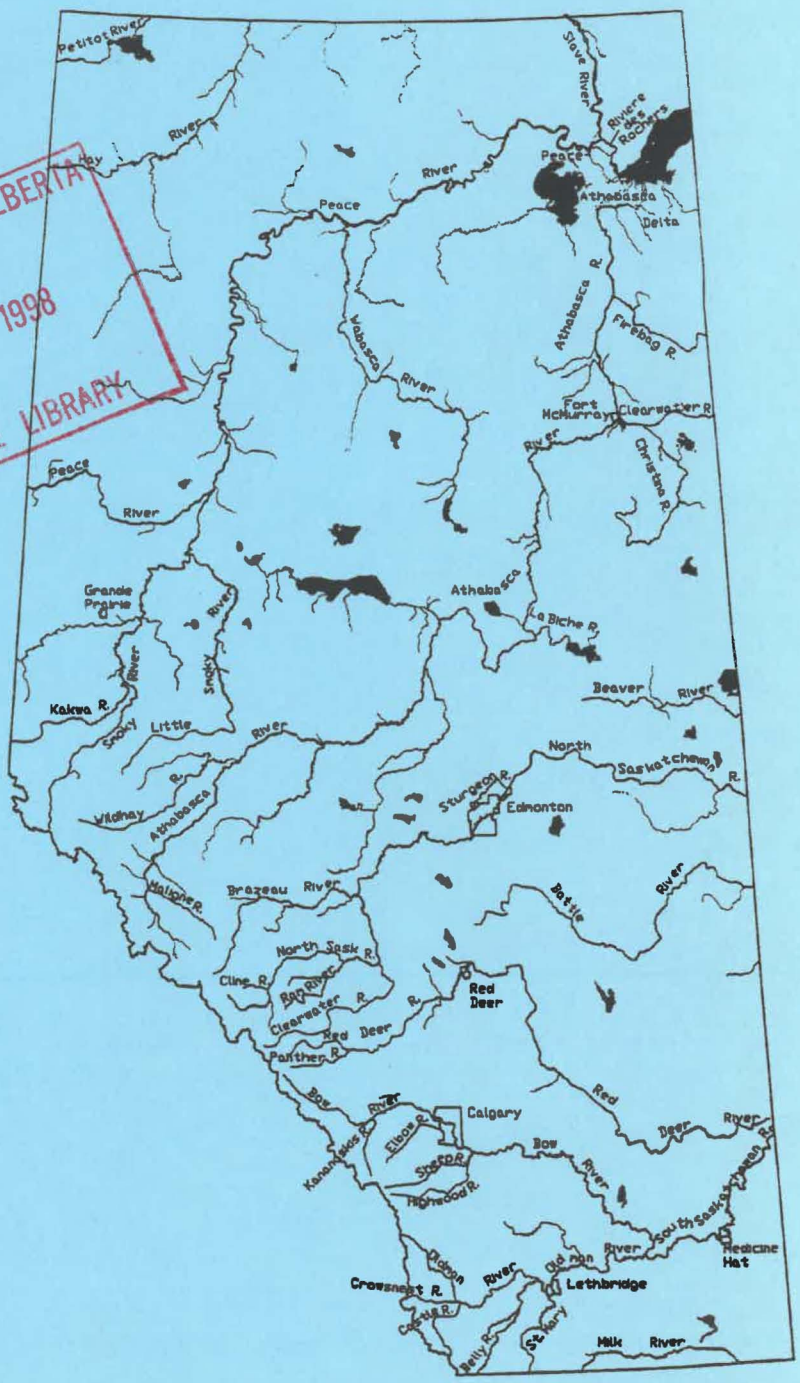
Canadian Heritage Rivers Systems

Study of Rivers in Alberta

RIVER INTEGRITY AND MANAGEMENT FEASIBILITY ASSESSMENT

Phase 3

FINAL REPORT



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1.0 INTRODUCTION

The Phase III report represents the final stage of the Alberta Canadian Heritage Rivers System (CHRS) study. It provides of an assessment of the management feasibility and integrity guideline compliances of 22 river candidates that were short-listed from Phase II. Along with heritage values, an assessment of management issues related to rivers is considered in the development of an evaluation system.

This report includes four sections. The first section summarizes the three phases of the Alberta CHRS study. Sections Two and Three deal with the Phase III assessment itself. The assessment includes a review of how each river meets certain integrity guidelines and then assesses how difficult it will be to manage selected rivers based on various resource management guidelines. The final section provides a summary of the key findings and conclusions derived in this study.

The study team re-assembled extensive background data, resource maps, field data and other sources of information in order to undertake the final phase assessment.

Following CHRS guidelines, integrity criteria were identified for each heritage theme and applied to each river. Then each river was assessed for its river management feasibility, identifying major resource management issues which could impact river integrity. Applicable Provincial and Federal Acts are reviewed as potential management tools.

By comparing both integrity guideline compliances and management feasibility, the study concludes with a short list of the rivers that most merit consideration for nomination to the CHRS system.

2.0 AN OVERVIEW OF THE ALBERTA CANADIAN HERITAGE RIVERS SYSTEM STUDY

2.1 Background

The Canadian Heritage Rivers System (CHRS) is a program developed and administered by designated departments of the federal, provincial and territorial governments to give national recognition to those Canadian rivers which best exemplify aspects of Canada's natural heritage, human heritage and recreation opportunities. The program, established in 1984, is administered by the Canadian Heritage Rivers Board, of which Alberta has become a member. Membership on the Board includes representatives from each of the 10 provincial and two territorial governments, as well as two appointees of the federal government. Currently, within Canada sections of 28 rivers (or river sections) totaling 6,349 km, have been nominated or designated to the system.

The implementation of the Canadian Heritage Rivers System study in Alberta is an important first step for the Province and the Canadian Heritage Rivers Board in undertaking a comprehensive assessment of Alberta's rivers for the purpose of identifying which rivers (or river segments) merit nomination to the Canadian Heritage Rivers System.

The implementation process adopted by Alberta in joining the Canadian Heritage Rivers Board specifies that local authorities will act as the lead agencies in recommending a river or reach for possible nomination by the Province to the CHRS system. This means that special interest groups, industries and private citizens must suggest a river from those short-listed in this systems study to a local authority, which in turn recommends the river to the Province for further study.

2.2 Study Objectives

The systems study is intended to identify and assess Alberta's rivers and to determine those which warrant inclusion on a list of rivers and reaches to be considered as potential candidates for nomination to the CHRS. The basis of this evaluation are to be the CHRS selection guidelines for natural heritage, human heritage, and recreational values, CHRS integrity guidelines, and the feasibility of managing the nominated rivers as Canadian Heritage Rivers.

Overall, this study develops an objective method of assessing the values of Alberta's rivers, and to use this methodology to produce a short-list of the most outstanding rivers in terms of natural and human heritage and recreational values. The short-list of rivers or river reaches would represent those which would merit nomination to the CHRS. To accomplish these tasks, the study was divided into three phases, which are described in more detail below.

2.3 Study Process

Each phase incorporates a number of tasks which are to be systematically completed. The three phases are outlined below with a brief description of the specific tasks to be undertaken.

Phase 1: The objective for this Phase was to establish a river evaluation framework, compatible with CHRS guidelines, but reflecting values and characteristics unique to Alberta's rivers. In addition an approach was developed to qualify which rivers would be short-listed for CHRS evaluation.

- Create a draft framework of assessment themes describing the characteristic features of Alberta's rivers within each of the natural, human heritage and recreation value categories.
- Complete a broad scale literature review for all of the initial candidate rivers put forward by the Alberta Government.
- Develop a short-list of rivers for detailed assessment through workshops with the consulting team and the Technical Advisory Committee.
- Finalize the thematic framework and develop an evaluation system based on defining criteria for each component within the framework.
- Produce a report summarizing the development of the thematic framework and the short-listing process of Phase 1.

Phase 2: The objective in this Phase was to apply the evaluation framework and develop a further short-list of rivers for more detailed assessment and qualification to be undertaken in Phase 3.

- Conduct a more detailed literature assembly and review focusing on those rivers short-listed for assessment

- Develop a public consultation process through local authorities, government agencies, technical experts, public interest groups and industries, to gather additional information regarding each of the short-listed river's heritage resources.

- Apply the thematic framework to each of the short-listed rivers to evaluate its resources, deriving a final score representing a comparative assessment of heritage values in each of the three main categories; natural, human and recreation.

- Submit the framework and results of the evaluation for public and technical review, through local authorities, government agencies, technical experts, public interest groups and industries.

- Produce a draft report summarizing the river assessments and a selection of candidate rivers for more detailed evaluation in Phase 3.

Phase 3: The objective of the final phase is to more specifically qualify the short-listed rivers selected for assessment from the Phase 2 results. This evaluation included first segmenting the major rivers into segments or reaches based on major encumbrances that could affect the overall assessment. Each river and segment was then evaluated according to how well it could meet certain integrity guidelines and meet river management capabilities. The outcome of this Phase results with a priority list of rivers felt to be the most suitable in meeting the necessary conditions for nomination to the CHRS system.

- Identify major obstacles or encumbrances (i.e. dams, industrial influences) and develop river segments

- Evaluate the integrity qualifications of selected short-listed rivers

- Develop and apply a methodology to assess the management requirements of the candidate rivers recommended for further evaluation.

- Categorize the candidate rivers according to those having the highest merit for nomination based on both integrity and management guideline evaluation

- Prepare a final report summarizing the complete study.

A listing of the highest scoring rivers as evaluated in Phase 2 within each theme category and as a combination is provided as a reference prior to initiating the detailed assessments for integrity and management feasibility.

3.0 INTEGRITY GUIDELINE EVALUATIONS

3.1 Methodology

Phase III of the study represents a further refinement in evaluating the highest scoring rivers from Phase II. This phase focuses on river integrity and the feasibility of maintaining and/or improving these integrity values through future resource and river management techniques.

The objective is to produce a list of rivers which merit nomination to the Canadian Heritage Rivers System.

The scope of Phase III is limited to those rivers which ranked highest for human heritage, natural heritage and/or recreation theme values as determined in Phase II. In all, 22 rivers qualified. The top 20 rivers (i.e. those with the highest combined human heritage, natural heritage and recreation scores from the Phase II analysis) were automatically included. As well, any river with a high score in any one theme (i.e. ranked in the top 8 for human heritage, natural heritage or recreation) was also included. The Little Smoky River was added because it ranked 8th for natural heritage. A further criterion was that each major drainage basin be represented. As the only representative from the Mississippi Drainage System, the Milk River was also included as the 22nd river.

The purpose is to apply the integrity guidelines to the 22 short-listed rivers and categorize them according to their overall potential as heritage rivers having the fewest management constraints.

The rankings of human heritage, natural heritage or recreation on any given river are not the sole criteria for nomination to the Canadian Heritage River system. Rivers or sections (reaches) of rivers must meet specified integrity value guidelines consistent with the principles of the CHRS program. One of the principles states that nominated rivers will be included if they meet one or more of the heritage value guidelines and all integrity guidelines. This includes both the general integrity guidelines and the specific integrity values associated with natural heritage, human heritage and recreation values. The criteria are based on similar criteria which have been applied to other provincial CHRS studies.

General Guidelines:

- Designated rivers or river segments should be of sufficient length to contain all or most of heritage resources to demonstrate the key aspects of the processes, features, activities or other phenomena which give the river its outstanding value.

- Designated rivers or river segments should contain sufficient natural components required for the continuity of a viable ecosystem

- The quality of the water should provide for the continuity and/or improvement of the river resources upon which "value" to the system has been determined.

Specific Guidelines

The following sections provide a more detailed evaluation of each of the short listed rivers applying specific integrity guideline criteria in each "heritage" category.

For this assessment all major rivers were first segmented into reaches based on points of major integrity guideline conflicts, which include items such as: dams, pulp mills, heavy industry etc. Map 1 illustrates how the rivers were segmented.

The specific integrity guidelines are applied separately for each river under each theme in order to provide a clear, independent evaluation that can be easily compared to how the rivers were previously scored in Phase 2. While the assessments for each theme could have been combined for each river (i.e. evaluating all three integrity guideline criteria river by river), it was felt that a truer evaluation of the integrity guidelines could be made if the assessments were kept separate.

In applying the specific integrity guidelines, each river or river segment as categorized into an "A" or a "B" classification reflecting higher or lower attainment of integrity values.

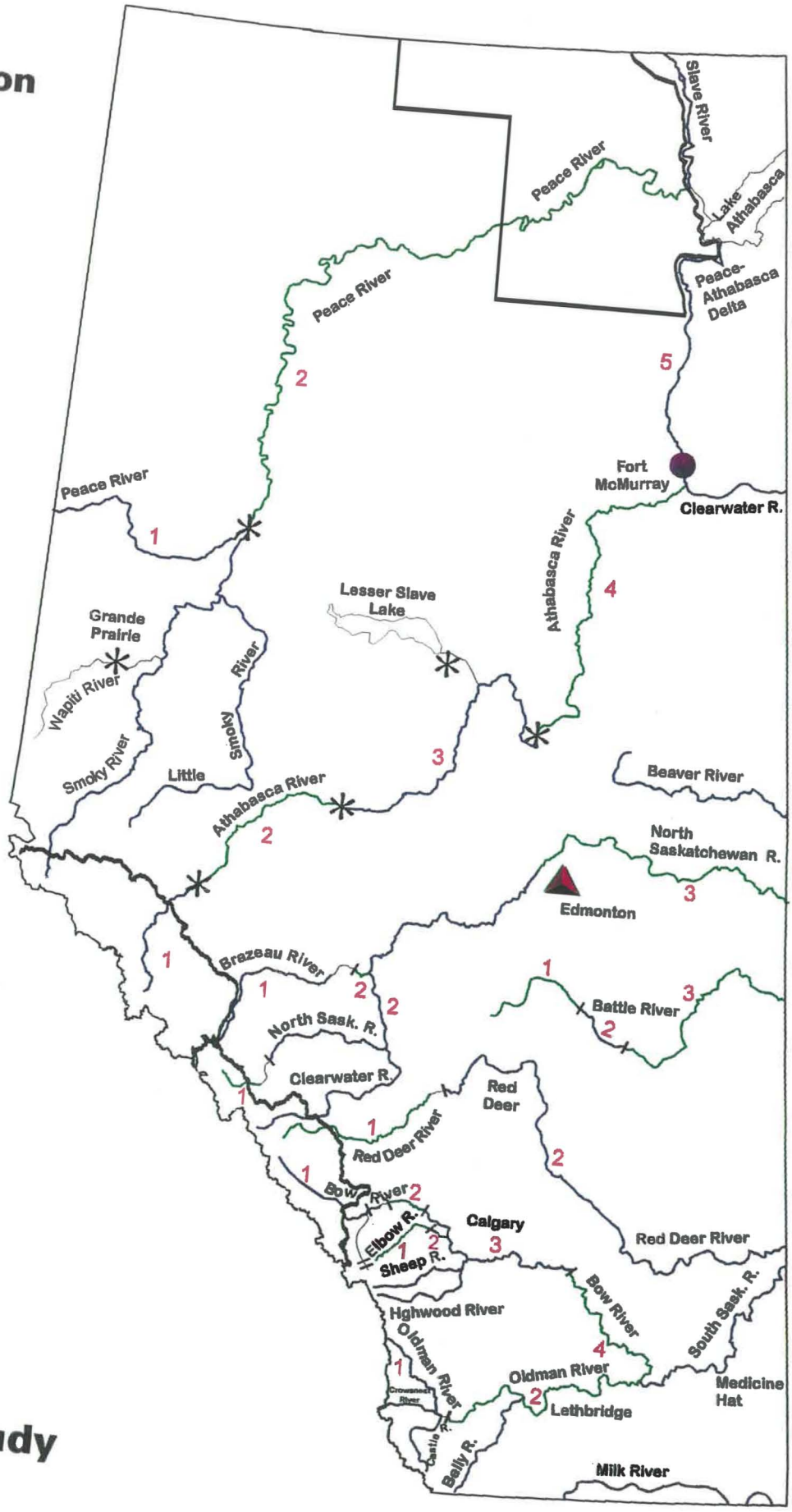
3.2 Natural Heritage Integrity Values

- Rivers should not have any man-made impoundments within the nominated section.

- All key elements and ecosystem components must be unaffected by impoundments located outside the nominated section.

Map 1

River Segmentation Criteria



Legend*

- Dam
- Pulpmill
- Oilsands
- Heavy Industry
- National Park
- Boundary

*alternating colours and numbers indicate distinct river segments

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- The natural values for which a river has been nominated must not have been created by impoundments.
- The river's outstanding natural heritage feature and key elements of ecosystems must be unimpaired by human land uses.
- The river's water quality must be uncontaminated to the extent that it's natural aquatic ecosystem is intact.

3.2.1 Natural Heritage Integrity Evaluation of River Segments

For natural heritage integrity values, the rivers and river segments were evaluated for outstanding, significant and unique natural features. Important features included falls, rapids, braided channels, high cliffs, exposed bedrock and badlands, which generally enhance the scenic attractiveness of the river and surrounding valley. Remote and pristine rivers also were judged to have high natural heritage integrity values. Another important consideration was river traverses any rare or under-represented natural regions or belonging to a unique drainage system in Alberta (e.g. Mississippi Drainage). Also of importance the presence of sites with high palaeontological significance or critical fish or wildlife habitat.

The following represents a general assessment of the important natural features associated with the rivers or river segments.

Athabasca

Segment 1 (S1.)
Jasper Park Boundary to Hinton

Most of the significant features above Hinton are located within Jasper National Park, where the Athabasca River already has heritage river status. Some natural features of note outside the park include one area of high palaeontological resource sensitivity located adjacent to this segment and the relatively rare Montane Subregion which is traversed. In addition, this segment is noted for its sections of active dunes extending from the National Park boundary.

S2. Hinton to Whitecourt

This segment of the Athabasca River has the occasional bedrock outcrop.

S3. Whitecourt to Athabasca

This section possesses high cliffs and split channels. Previous river research has identified two areas of significance adjacent to this segment: the proposed Fort Assiniboine-Holmes Crossing Conservation Natural Area and the Chisholm-Lake Gray Area. (AWA, 1990)

S4. Athabasca to Fort McMurray

Several sets of rapids are located on this segment of the river, with the Grand Rapids the most notable. This segment also has areas of great scenic value and rugged wilderness as well as some sites with high palaeontological significance. Other research has identified the Loon-Thickwood Area as an area of importance and also has proposed that the entire segment be considered as a Natural River (AWA, 1990).

S5. Fort McMurray to Lake Athabasca

This section possesses several key and unique natural features, including dramatic gorges near its confluences and several areas of high palaeontological resource sensitivity. The Peace River Lowlands Natural Subregion is well represented, especially in Wood Buffalo National Park. The Peace-Athabasca Delta is the largest freshwater delta in the world and a key migratory bird staging area. The nearby Athabasca Dunes-Richardson Lakeland Area (proposed Wildland Recreation Area by AWA) is another site of natural heritage significance.

Battle

S1. Battle Lake to Dried Meat Lake

Several areas of high palaeontological significance and prime habitat for ungulates are located adjacent to this segment of the Battle River.

S2. Dried Meat Lake to Forestburg Dam

This segment has areas of exposed bedrock and interesting geomorphic features, including a well-developed spillway channel in the Bigknife area. Fossil exposures and badlands vegetation also enhance the scenic viewing of this section of the Battle River. This segment contains prime areas for waterfowl and ungulate production.

S3. Forestburg Dam to Saskatchewan border

This section also contains areas of exposed bedrock, interesting geomorphic features and scenic viewing. Several sites of high palaeontological significance have also been located along this segment. The river valley contains prime habitat for ungulates.

Beaver

The Beaver River forms the western most part of the Churchill River Drainage System and is the only candidate representing this drainage system from the Alberta CHRS short-listed rivers. The segment of this river in Alberta has some excellent wilderness characteristics. Some class II rapids may be present at high water levels and it is also the only known stream in Alberta with crayfish (Travel Alberta, 1978c). Finally, the Beaver River flows through one of the most important areas for migratory waterfowl in Canada (Poston et al., 1990).

Belly

The Belly River offers a wide diversity of geological and morphological features, ranging from mountains to incised channels. This river also passes through the Montane and Foothills Parkland Subregions, which are both relatively rare in Alberta. The river terraces support an important cottonwood riparian ecosystem (Woodbay Consulting Group Ltd., 1992). A portion of the Belly River has also been proposed as a Natural River by AWA (1990).

Bow

S1. Canmore to Morley

Braided channels and class III rapids are present on this part of the Bow River (Travel Alberta, 1978e). This section of the Bow River traverses the Montane Subregion and has some spectacular scenery.

S2. Ghost River Dam to Bearspaw Dam

The Bow River has class II and III rapids between these two dams (Travel Alberta, 1978e). This segment passes through the ecologically important Montane and Foothills Parkland Natural Subregions and also includes areas with scenic views.

S3. Calgary to Bassano Dam

This segment carves a spectacular canyon through sandstone and also has some exposed fossil clam beds near the Highwood River confluence. This entire section traverses the Grasslands Natural Region with representation from the Foothills Fescue, Mixedgrass and Dry Mixedgrass Subregions. The Bow River downstream of Calgary is a very productive fishery with both cold and warm water species: mountain whitefish, rainbow trout, brown trout, bull trout, cutthroat trout, northern pike, walleye, goldeye, Some locally important migratory bird habitat has also been identified along this segment.

S4. Bassano Dam to South Saskatchewan River

The last segment of the Bow River, which is located within the Dry Mixedgrass Subregion, has some areas of high palaeontological significance and some important migratory bird habitat.

Brazeau

S1. Above Brazeau Dam

This section has a high diversity of geological attributes and visual attractions ranging from mountains to plains. Several sets of rapids and areas with braided channels are present, while the water quality is excellent. This segment passes mainly through the Upper Foothills, however, the Sub-Alpine Natural Subregion is represented in its upper reaches, and the Lower Foothills in its lower reaches.

S2. Below Brazeau Dam

This relatively short segment is entirely located within the Lower Foothills Natural Subregion.

Castle

The Castle River possesses several sets of rapids and excellent water quality. The landscape is scenic with great geological variation. A high diversity of ecosystems are encountered in short distance, as the river passes through the Sub-Alpine, Montane and Foothills Fescue Subregions. The Castle River contains important bull and cutthroat trout habitat. A large number of rare and endangered species are located in the surrounding area, including the last secure grizzly bear habitat in southwestern Alberta outside of Waterton Lakes National Park (Gibbard and Sheppard, 1992).

Clearwater (Athabasca)

The Clearwater (Athabasca) River contains the Whitemud Falls and 14 rapids within a 22.5 km stretch from the Falls to Edwin Creek (Travel Alberta. 1978a). Hoodoos, caves, overhangs and sulfur springs are present near Pine Rapids (Travel Alberta, 1978a). Some significant palaeontological sites have also been located adjacent to the river in Alberta. Although this river has areas of tar seepage, water quality is generally very good. Most of the Clearwater (Athabasca) is very remote and the entire section within Alberta has been proposed as a Natural River by AWA (1990).

Clearwater (North Saskatchewan)

This tributary of the North Saskatchewan River contains numerous rapids, braided channels and sweepers (Travel Alberta, 1978d). A high diversity of geological characteristics and Natural Subregions (including the Alpine, Sub-Alpine, Upper Foothills, Lower Foothills and Dry Mixedwood Subregions) are traversed by this river. The Clearwater (North Saskatchewan) is a wild and scenic river with excellent water quality. The river valley also contains areas of high palaeontological resource sensitivity as well as prime habitat for both ungulates and bull trout.

Crowsnest

This river has excellent representation of a variety of geological and visual features and some important palaeontological findings have been made adjacent to it. The Crowsnest River also contains the Lundbreck Falls and prime trout habitat.

Elbow

S1. Above Glenmore Reservoir

This section contains the Elbow Falls, several sets of rapids, braided channels and has a very steep gradient. Diverse landscapes are traversed by this segment, ranging from mountains to plains. The Sub-Alpine and Foothills Parkland Natural Subregions are included in this part of the Elbow river.

S2. Below Glenmore Reservoir

This entire segment is located within the City of Calgary, therefore, natural attractions are minimal.

Highwood

The Highwood River contains falls, several sets of rapids, braided channels and canyons. Prime fish habitat can be found along the entire river.

Little Smoky

This river traverses an area of high diversity in both physiography and vegetation. Some class III rapids are present (Travel Alberta, 1978b). The Little Smoky River is enclosed by a steep valley with sandstone cliffs near the Smoky River confluence, while an extended area of high palaeontological significance is located near Valleyview. Excellent ungulate habitat is present along most of this river. The AWA (1990) has identified the Little Smoky Area near the headwaters as an area with significant recreation/natural features.

Milk

The Milk River exhibits a high diversity of morphological features, including hoodoos and table rocks. The eastern reach of the river, which has been proposed as a Natural River by AWA (1990), is of particular interest. Here the canyon, river bottom and surrounding upland offer some of the most spectacular scenery on the prairies (Wershler, 1990). A large proportion of the river valley has areas of high palaeontological significance. The valley also contains an extensive riparian (cottonwood) woodland ecosystem and some of the largest remaining tracts of mixed grassland in Canada occur on the adjacent uplands (Wershler, 1990). Numerous rare and endangered species inhabit the river and associated habitats, including some that do not occur anywhere else in Canada (e g. yucca plant and Weidmeyer's Admiral Butterfly). The Milk River is the only Alberta CHRS short-listed river that is part of the Mississippi drainage that flows into the Gulf of Mexico.

North Saskatchewan

S1. Banff Park Boundary to Abraham Lake

Most of the river above Abraham Lake is located within Banff National Park, where the North Saskatchewan has already been designated as a Heritage River. The short segment between the park boundary and Lake Abraham consists mostly of a braided stream with powerful eddies (Travel Alberta, 1978c) and is entirely located within the Montane Subregion. The Kootenay Plains Ecological Reserve protects an important area of natural heritage.

S2. Bighorn Dam to Fort Saskatchewan

This reach of the North Saskatchewan River flows through a braided channel near Nordegg that soon becomes a single channel. Several sets of rapids are encountered upstream of Rocky Mountain House, including the Gap Rapids, Saunder's Rapids, Devil's Elbow, Old Stony, Fisher's Rapids, Grier Rapids and Brierly Rapids (Travel Alberta, 1978c). Also of interest are sandstone cliffs and the occasional islands. An area of high palaeontological resource sensitivity is located adjacent to the river between Drayton Valley and Devon. The river valley provides excellent ungulate habitat and as well as locally significant migratory bird habitat. A large number of endangered and rare species also inhabit the river, the river valley and adjacent habitats (see Alberta CHRS Phase 2 report).

S3. Fort Saskatchewan to Saskatchewan Border

Downstream from Edmonton, the North Saskatchewan River is generally slow-moving and contained within a broad valley. This section forms a rough boundary between the Dry Mixedwood and Central Parklands Natural Subregions.

This reach passes almost entirely through agricultural lands, however, it provides critical ungulate and migratory bird habitat.

Oldman

S1. Above Oldman Dam

This reach of the river contains numerous rapids, ledges and braided sections as well as the Gap Waterfall, which is a narrow gorge cut through the Livingstone Range. This segment passes through the Sub-Alpine, Montane and Foothills Fescue Subregions.

S2. Below Oldman Dam

Some small rapids are present on the second reach of the Oldman River. The section between Lethbridge and Grand Forks offers beautiful scenery and extensive areas of high palaeontological resource sensitivity. Although the section of the river below the Oldman Dam begins in the Foothills Fescue Subregion, most of it is located in the Mixedgrass and Dry Mixedgrass Subregions. Extensive areas of prime fish, ungulate and migratory bird habitat are located along this segment.

Peace

S1. Above Peace River (town)

This reach of the Peace River is flanked by hills rising to 275 metres with north-facing slopes dominated by aspen and south-facing slopes with open grassland (Travel Alberta, 1978b). This segment traverses mostly the Dry Mixedwood Subregion, although a minor proportion comes in contact with the relatively small Peace River Parkland Subregion. The Silver Valley Ecological Reserve is located on this section. Most of the reach contains areas of high palaeontological resource sensitivity and excellent ungulate wintering habitat. Water quality is generally good up to the Smoky river confluence.

S2. Peace River (town) to Wood Buffalo Park Boundary

There are many sand and gravel bars on this segment, while the Vermillion Chutes and Falls and Boyer Rapids are spectacular (Travel Alberta, 1978b). Downstream of the Town of Peace River the valley is relatively unaltered with many sections that are extremely remote. Most of this reach is located within the Dry Mixedwood Natural Subregion, with some in the Peace River Lowlands and a very minor proportion in the Peace River Parkland and Central Mixedwood. This section contacts several areas of natural significance, including Wood Buffalo National Park and Notikewin Provincial Park, as well as areas identified by AWA as having significant natural features (Peace-Cadotte Wildland and Child Lake Prairie). About one-third of the reach contains important migratory bird habitat (Poston et al., 1990).

Red Deer

S1. Banff Park Boundary to Glenifer Lake

Several sets of rapids, chutes, sweepers, eddies, log jams and braided channels are present on the upper reach of the Red Deer River (Travel Alberta, 1978d). This section of the river flows through a great diversity of Natural Subregions, including Sub-Alpine, Upper Foothills, Lower Foothills, Montane and Dry Mixedwood. Excellent ungulate habitat occurs along this segment.

S2. Below Dickson Dam

The second reach of the Red Deer River travels through significant areas of badlands with spectacular scenery and is located within the Central

Parklands, Northern Fescue, Mixedgrass and Dry Mixedgrass Subregions. Most of this section also passes through areas of high palaeontological resource sensitivity. The river valley and surrounding uplands represent critical habitat for several endangered and threatened species. Several research studies provide extensive documentation of extremely important habitat for ungulates exists adjacent to the river, including a wintering area for pronghorn antelope. The river also contains important warm water habitat for fish downstream of Red Deer. Between Hwy. 36 and the Saskatchewan border, the Red Deer has been proposed as a Natural River by AWA (1990). Other significant areas include Dry Island Buffalo Jump and Dinosaur Provincial Parks and several proposed natural areas and ecological reserves (AWA, 1990).

Sheep

A very scenic river with a varied landscape, the Sheep River flows through the relatively rare Foothills Parkland Natural Subregion. The river provides good cold water fish habitat (Longmore and Stanton, 1981).

Slave

The Slave is a large river with greatest volume of water of all Alberta rivers. Four major sets of rapids are located on this river in Alberta. It is very remote and has been proposed as a Natural River by AWA (1990). The Slave River is almost entirely located within the Peace River Lowlands, although it is one of the few Alberta rivers that contact the Kazan Uplands Subregion of the Canadian Shield. Several important palaeontological sites are located adjacent to the river. The most northerly pelican colony in North America can be found on the Slave, where the AWA (1990) has also proposed the Pelican-Portage Ecological Reserve near the NWT border. Locally important migratory bird habitat has been identified along the east side of the river (Poston et al., 1990). The west bank of the river forms the boundary of Wood Buffalo National Park.

Smoky

The Smoky River has three major sets of rapids: Hell's Creek Rapids, the 'Chutes' and the Cutbank Rapids (Travel Alberta, 1978b). The river also has braided sections with gravel bars and areas of large cliffs with spectacular hoodoos (Travel Alberta, 1978b). The Smoky River traverses a great variety of geological formations and ecosystems, including the rare Montane and Peace River Parkland Subregions. Numerous areas of high palaeontological significance and important ungulate habitat are located along this river.

South Saskatchewan

The South Saskatchewan has one major rapid: Rapid Narrows, and is located exclusively within the Dry Mixedgrass Subregion in Alberta. This river offers impressive prairie wilderness scenery (Travel Alberta, 1978e) and extensive areas of high palaeontological significance. The Middle Sand Hills National Wildlife Area in Suffield Military Reserve and proposed Prairie Coulee Ecological Reserve are located adjacent to the river. Important cottonwood groves can be found on wide river terraces. The river and associated environments represent critical habitat for numerous endangered and rare species (see Alberta CHRS Phase II Report), while half of the river in Alberta lies adjacent to areas of regional importance for migratory birds (Poston et al., 1990). The South Saskatchewan River also supports a provincially important Lake Sturgeon population (Longmore and Stanton, 1981).

3.2.2 Natural Heritage Integrity Classification

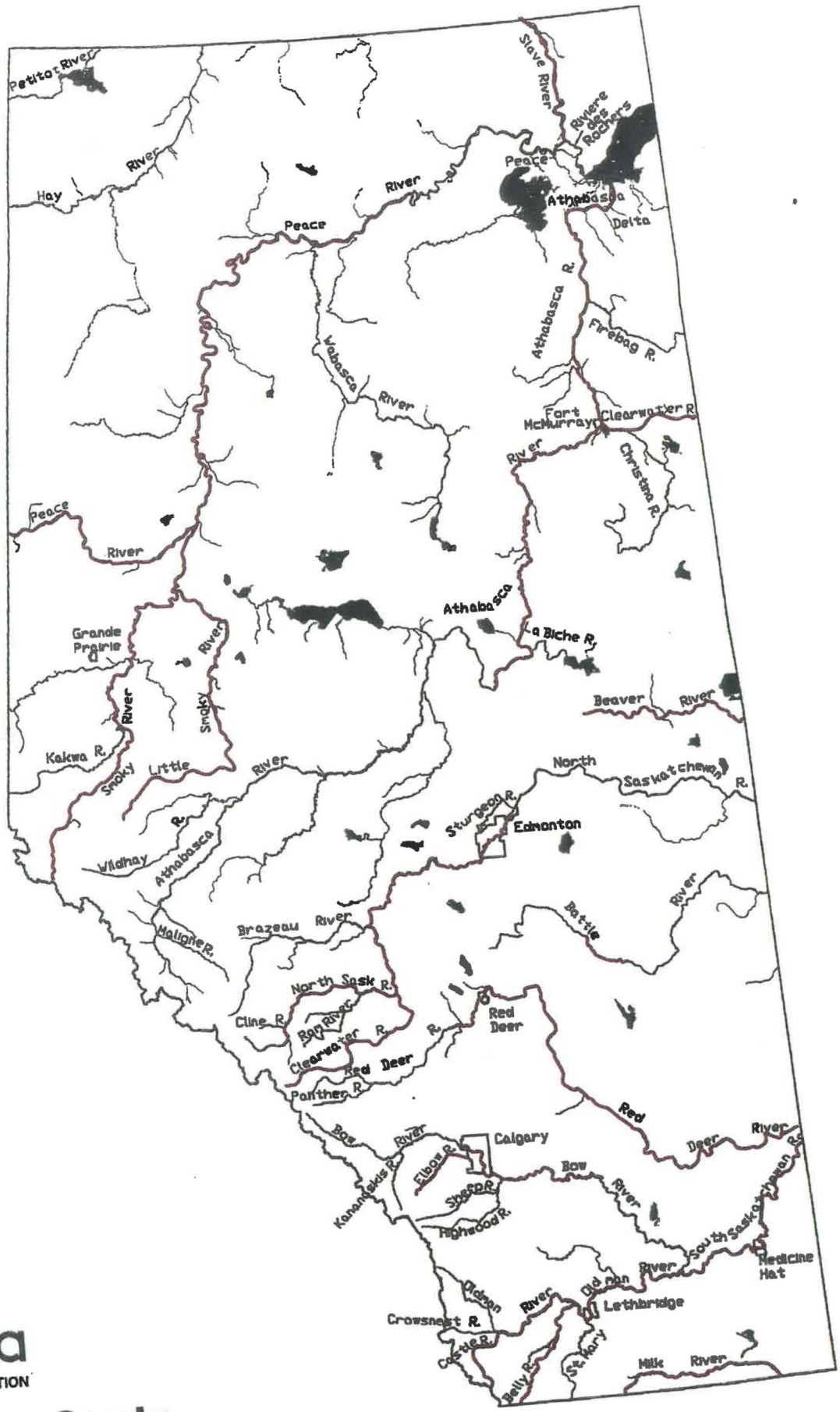
As a result of this evaluation, each of the short-listed rivers is classified into an "A" or "B" category representing how strongly they meet natural heritage integrity guidelines.

"A" rivers reflect the highest integrity and are illustrated on Map 2. "A" rivers for natural integrity include:

Athabasca Segments - 4 and 5
Battle - Segment 2
Beaver
Belly
Bow - Segment 3
Castle
Clearwater (Athabasca)
Clearwater (North Saskatchewan)
Elbow - Segment 1
Milk
North Saskatchewan - Segments 1 and 2
Oldman - Segment 2
Peace - all segments
Red Deer - Segment 2
Slave
South Saskatchewan

Map 2

"A" Rivers for Natural Heritage Integrity



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3.3 Human Heritage Integrity Values

As human heritage can transcend physical manifestations (i.e. notable locations such as early exploration routes, battlefields, treaty signing locations, etc.), integrity values are not conclusive. It should also be noted that while existing and developed human heritage sites can be readily assessed for their significance, there are many potential historic and archaeological sites which haven't been developed but that should be taken into consideration. However, higher value would be afforded sites/areas in their original or near original condition, which may include the greater cultural landscape. As such, greater human history value would be assigned a river or river segment if:

- the segment under consideration has the same or nearly the same visual appearance as would be expected during the period for which a human heritage value is considered;
- most of the artifacts comprising the human heritage value for which the segment is nominated are unimpaired by impoundments and human land uses; and
- neighboring land uses do not seriously impact the human history experience under consideration. (This might include agricultural uses which represent a particular period of human settlement, i.e. river lot farming along the Sturgeon and North Saskatchewan River);
- The biophysical quality of the water does not impact the human history experience.

3.3.1 Preliminary Human Heritage Evaluation of River Segments

Objective measures of human heritage are difficult to establish as historical and cultural places, events and/or personages are not equally comparable. To identify known areas of human heritage value, a preliminary evaluation of the short listed rivers has been prepared using the Significant Sites and Areas Listing prepared by Alberta Community Development, current to January 31, 1993. While this is not an exhaustive listing, nor have all areas of the province been equally examined or evaluated, it does provide a crude measure of determining areas of high human heritage value. Elaboration and confirmation of the data compiled to date must be undertaken at the nomination stage for any potential Canadian Heritage River in Alberta.

Athabasca

The Athabasca River is an extremely important feature in Canadian history. It was a major fur trade route, used primarily to gather and transport furs and supplies between the Churchill and Mackenzie drainages. As a result, most of the designated sites along the Athabasca River relate to the early fur trade, including Native settlements drawn to the fur trade posts. Precontact Native occupations are also represented along the river.

S1. Jasper Park Boundary to Hinton

At least six recorded significant sites occur within this segment of the Athabasca River. Most sites are concentrated in the Jasper area and relate to the fur trade (John Moberley House), early Native (burials) and non-Native residents (St. Mary and St. George Anglican Church). Occupation above Brule Lake and in the Hinton area, which is also of note, has helped define this segment of the Athabasca.

S2. Hinton to Whitecourt

No sites in this segment were included on the Significant Sites and Areas Listing as of January 31, 1993, however, there is a historical crossing of the Grande Prairie Trail at a ford on this segment.

S3. Whitecourt to Athabasca

At least two significant sites have been recorded along this segment. Fort Assiniboine was an important fur trade provisioning point and was later the junction of the trail joining the Athabasca route with the North Saskatchewan route via Fort Edmonton. Athabasca Landing also served as a divisional point between the North Saskatchewan and Athabasca river routes after 1884.

S4. Athabasca to Fort McMurray

Three sites have been included on the significant sites listing in this segment. Two relate to the fur trade, including the Grand Rapids Portage and Fort of the Forks near modern Fort McMurray. The House River cemetery is also recorded as a significant site.

S5. Fort McMurray to Lake Athabasca

Six sites of significance occur on this length of the river. Two significant Native sites are the Beaver River Sandstone Quarry and the Cree Burn Lake Site. Two cabins may also be Native in origin. Former fur post HiOv 3 (Pierre au Calumet Post) and the Bitumount townsite are also significant sites on this segment.

Battle

No sites on this river have been included on the Significant Sites and Areas Listing as of January 31, 1993, although there is an early Methodist mission.

Beaver

One site on the Beaver River, Portage La Biche, has been included on the Significant Sites and Areas Listing. This site relates to the eighteenth and nineteenth century fur trade route linking the Churchill drainage and the Athabasca via Beaver River, Lac la Biche and the La Biche River.

Belly

At least 14 sites along the Belly River have been included on the Significant Sites and Areas Listing. They include nine Native sites consisting of stratified campsites, a bison jump, and a burial. Historic sites include whiskey posts and North West Mounted Police posts and outposts.

Bow

The Bow River was an important geographical feature prehistorically and in later historic times following the signing of Treaty No. 7. A large number of significant sites have been recorded along its entire length.

S1. Canmore to Morley

A large number of significant sites have been recorded in the vicinity of the Canmore townsite. Prehistoric sites include at least five stratified campsites (EgPu 19, EgPu 20, EgPt 6, EgPt 3, EgPt 17), a kill site (EgPs 51), and other sites (EgPs 14, EgPs 48, EgPs 47, EgPs 1). Historic sites include Peigan Post (EgPr 1), Georgetown (EgPu 8), Old Kananaskis (EgPs 27), Exshaw (EgPt 113), Canmore Relief Camp (EgPt 11), Steele Brothers' Residence (EgPs 24), Butchert Lime Kilns (EgPt 12) and the original East Gates of Rocky Mountain National Park (EgPs 25).

S2. Ghost Dam to Bearspaw Reservoir

Ten sites on the Significant Sites and Areas Listing lie within this segment including five prehistoric sites (kill EgPn 290, camp EgPn 219, EhPo 36, the Coal Creek site EhPp1, and a Paleo-Indian blow-out site EhPp 6) and five historic sites (ranch EgPo 59, Glenbow townsite EgPo 18, Grand Valley coal mine EhPp 4, McDougall United Church at Morleyville, and the Morleyville Mission EhPq 6). These sites reflect the long Native occupation of the area and the late nineteenth and early twentieth century non-Native settlement of the area. Morleyville is notable in its association with important early missionaries George and John McDougall.

S3. Calgary to the South Saskatchewan River

At least twelve significant sites are located on the Bow River within the City of Calgary, including several significant prehistoric sites (EgPm 124, EfPl 111, EfPm 143, EfPm 27, EfPm 122), as well as historic buildings/structures such as the Deane House, Fort Calgary, the Burns Ranch, and the Hextall (Shouldice) Bridge. An additional twelve significant sites are located downstream of Calgary. Important prehistoric sites include the Cluny (Siksika) Earthlodge Village (EdPf 1), Majorville Cairn Complex (EdPc 1), Blackfoot Crossing (EdPf 6), Jamieson's Place Medicine Wheel (EePi 2), stratified site EfPk 1, ring site EePg 1, EfPm 2, EePk 258, and a burial at EdPk 5. The Cluny Earthlodge Village is perhaps one of the most significant sites in the Prairie Provinces. Historic sites include Berry & Shear's Whiskey post (EePk 285), St. Joseph's Industrial School Cairn and the Dunbow outpost (EePk 271). Blackfoot Crossing was also the location of the signing of Treaty No. 7.

Brazeau

No sites on this river have been included on the Significant Sites and Areas Listing as of January 31, 1993.

Castle

At least nine sites on the Castle River have been included on the Significant Sites and Areas Listing. All of the sites are native in origin, including stone feature sites DjPm 213, DjPm 214, DjPm 154, DjPm 156, DjPm 155, DjPm 218 and DjPm 219, and buried sites DjPm 64 and DjPm 206.

Clearwater (Athabasca)

Three significant sites occur in association with this river which was an important fur trade route in the nineteenth century. The sites include Pine Portage (HeOm 2), a cabin (HeOo 1) and the Fort of the Forks at the mouth of the Clearwater.

Clearwater (North Saskatchewan)

Three significant sites, all burials, occur on this river. Relatively little intensive investigation has been conducted in this region.

Crowsnest

The Crowsnest River has a very dense record of human history, both historic and prehistoric. No fewer than 33 sites on the river have been include on the Significant Sites and Areas Listing. At least nineteen prehistoric sites of significance occur on the Crowsnest, including pictographs, campsites, and lithic reduction sites. Historic sites reflect the early mining history of the region and include the Leitch Collieries, Blairmore Brick Factory, Frank townsite and slide area, Greenhill Mine complex, and other settlements. The Crowsnest River area constitutes one of the densest concentration of significant sites and areas in Alberta recorded to date.

Elbow

S1. Above Glenmore Reservoir

One significant site, Our Lady of Peace Catholic Mission, has been included on the Significant Sites and Areas Listing as of January 31, 1993.

S2. Below Glenmore Reservoir

No sites below the Glenmore Reservoir have been included on the Significant Sites and Areas Listing as of January 31, 1993.

Highwood

Six sites on the Highwood River are included on the Significant Sites and Areas Listing, all of which are historic in nature. Whiskey trading was important in the area and three posts occur on the Highwood, Aker's and Johnson's Spitzee Post, Harris and Sample (Spitzee) Post, and Barry and Shear's whiskey post. Also included are the Sexsmith homestead, the Nurse's residence in High River and the Hitchner Cairn.

Little Smoky

No sites on the Little Smoky River are included on the Significant Sites and Areas Listing as of January 31, 1993.

Milk

The most prominent significant area on the Milk River is the Writing-On-Stone complex, consisting of over 100 sites, mainly rock art. Writing-On-Stone is the densest concentration of rock art in Western Canada and the Northern Plains. The Milk River was also an important North West Mounted Police area due to the proximity of the international border. Two outposts on the Milk River are on the significant sites listing.

North Saskatchewan

The entire North Saskatchewan River is an important geographic feature for human heritage. Prehistorically, it was an important boundary between Plains and woodland oriented Native groups. It also formed a boundary for the large Plains bison herds which were so valuable to prehistoric and historic people. A large number of prehistoric sites are associated with the river. Historically, the North Saskatchewan was a critical fur trade route and later charted the course for overland routes into Alberta.

S1. Banff Park Boundary to Abraham Lake

The upper stretches of the North Saskatchewan River are located in Banff National Park and a separate inventory of cultural sites is maintained by Parks Canada. Outside of the Park, however, at least four sites/locales of significance were identified, including the Kootenay Plains (a ceremonial area for First Nations with probable prehistoric associations), Sundance Lodges, and two burial grounds.

S2. Bighorn Dam to Fort Saskatchewan

There are at least 18 significant sites on this segment of the North Saskatchewan River. One prehistoric site of significance occurs on this stretch, the Stony Plain Quarry Site (FiPm 6). Significant fur trade era sites on this segment include the Rocky Mountain House complex, comprised of four separate posts, Boggy Hall, and Upper Terre Blanche. A farm in association with Rocky Mountain House is also considered significant as well the river lot settlement at Lamoreux. There are also historical river farm lots near Fort Saskatchewan.

S3. Fort Saskatchewan to Saskatchewan Border

This segment of the river is particularly rich in early fur trade sites. Significant sites include Fort Vermilion/Paint Creek House, Fort George/Buckingham House, Fort de L'Isle, Fort Victoria, Fort White Earth and Dog Rump House. Victoria Mission was an important early mission operated by George McDougall and his family. In the vicinity of Fort Saskatchewan are the sites of Fort Augustus/Fort Edmonton I and the Fort Saskatchewan North West Mounted Police post. A number of significant sites were identified within the Edmonton city boundaries, including Fort Edmonton II and IV, an historic coal mine (FjPi 42), and numerous notable historic structures, as well as the Rossdale Power Plant Burial site (FjPi 63).

Oldman

The Oldman River is an extremely important area for prehistoric, historic and modern First Nations, and also has a rich non-Native history. The name Oldman refers to Napi, an important figure in Plains Indian creation stories. The Oldman River valley is a spiritual center for Plains peoples, particularly the Peigan. The proximity of the river to the Crowsnest Pass also made the area part of a trade corridor both historically and prehistorically. The ranching history of the region is also important, as is the whiskey trade.

S1. Above Oldman Dam

At least five sites of significance have been recorded above the Oldman Dam. Four are prehistoric sites, including a bison jump, kill site, and a buried campsite. The remaining site is an historic homestead (DlPn 2).

S2. Below Oldman Dam

A very large number of significant sites/areas (>40) have been recorded on the Oldman River below the dam. The sites occur on the whole length of the river but concentrations are notable near the confluence of Pincher Creek, the Belly River, Saint Mary's River and Little Bow River. In the vicinity of Lethbridge, over 50 sites of significance have been noted, both historic and prehistoric. Some of the most notable sites on or adjacent to the Oldman River below the dam are the Kenney Site (DjPk 1), Victoria Jubilee Mission, Fort Whoop-Up (DjPf 2), Nitapinaw Medicine Wheel (DjPf 23), the Sheran Mine (DkPf 43), the Many Spotted Horses Medicine Wheel (DkPf 1), Conrad Post (DkPf 2), the Junction Site (DkPi 2), Fort MacLeod I (DkPi 17), Fort MacLeod II (DkPi 18), the Ross Site complex

(DkPd 1, 2 and 3), the Taber Child Burial (DlPa 4), the Bayrock site (DkPb 2), and historic structures in both Fort MacLeod and Lethbridge.

Peace

The Peace River was an extremely important fur trade route during the nineteenth century. It was the main corridor to both the Arctic and interior British Columbia trade networks. The unusual climatic and geographic conditions in the Peace River Prairie have allowed an important agricultural base to develop in the region which resulted in large scale settlement in the early twentieth century.

S1. Above Peace River (town)

Nine significant sites in two clusters have been identified on the Peace River above the confluence of the Smoky River. Five sites in the historic Dunvegan settlement have been recorded as significant and include Fort Dunvegan (GlQp 3 and GlQp 8), specifically the Factor's House at Fort Dunvegan, St. Saviour's Anglican Mission (GlQp 7), St. Charles Catholic Mission (GlQp 6), and Twelve-Foot Davis' Post. Four sites have been identified near the modern community of Peace River and consist of St. Augustine's Mission, Fort Fork (HaQi 1 and 7), St. Mary's House II and III (McLeod's Fort) (HbQi 5) and a native camp at St. Mary's House.

S2. Peace River (town) to Wood Buffalo Park Boundary

Eleven sites of significance have been identified downstream of the community of Peace River. Most relate to the fur trade, although native sites are included. At the confluence with the Notikewin River, four sites have been identified including Horse Shoe House, Battle River Post (HhQg 2), the Notikewin River Stratified Campsite (HhQg 3), and the Notikewin Burial (HhQg 5). Aspin House (IbQd 1) is nearby. In the vicinity of Fort Vermilion, there area four sites of significance consisting of Fort Liard/Boyer's Post/Mansfield House (IcPx 16), the Sheridan Lawrence Ranch, Hay River Post (IcQa 2), and the Old Bay House in Fort Vermilion. Further downstream are the Little Red River Post and Wentzel's Post.

Red Deer

The Red Deer River has a rich prehistoric record for most of its length. The river traversed the grasslands favoured by the great bison herds on which historic and prehistoric peoples depended. Of particular note on the Red Deer River is the Dinosaur Park World Heritage Site where highly significant palaeontological finds have been made and where numerous prehistoric sites have been recorded.

S1. Banff Park Boundary to Glenifer Lake

No sites of significance were noted on the Red Deer River above Glenifer Lake.

S2. Below Dickson Dam

At least 12 significant prehistoric sites have been recorded on or adjacent to the Red Deer River. It is notable that many of these sites are ceremonial in nature, such as medicine wheels. Ceremonial sites include EfOp 414, a medicine wheel, the Wetzel Rock Alignment (EfQq 82), Rinker Medicine Wheel (EfOp 58), Miner's #1 and #2 Medicine Wheels (EfOo 10), Suitor site effigy/medicine wheel (EgOx 2), and the Hutton Medicine Wheel/Cairn (EgOx 46). Other prehistoric sites include EfQg 82 (camp/rings), Suitor Ranch Site EgOx 1, ElPf 10, Huxley Bison jump, Dry Island Buffalo Jump (ElPf 1), Miller Site camp and jump (FbPi 1) and a burial (EfOt 6). Metis sites include a village (EfOt 5) and the Green Wintering Site (ElPg 2). The Old Mexico Ranch (EeOu 4) in Dinosaur Park was an interesting element of ranching history in Alberta. At least seven sites occur in the vicinity of the City of Red Deer and include three designated buildings, the Red Deer Indian School (FbPl 17), the Red Deer Indian School Burial (FbPl 18), Squaw Point Burial (FbPl 15) and Fort Normandeau (FbPl 10).

Sheep

The Sheep River has a good prehistoric record and was a focus of early ranching activities in the area. Five sites on the Sheep River have been included on the Significant Sites and Areas Listing as of January 31, 1993. The prehistoric sites consist of the Canyon Creek site (EdPp 21), the Okotoks (Big Rock) Erratic (EePm 3), and a campsite (EePm 63). Historic sites consist of an unspecified number of cabins (EdPp 3) and the Old Lineham House in Okotoks.

Slave

The Slave River was also an important fur trade and exploration river but its length within Alberta is limited. Three significant sites have been recorded on the river, consisting of a native site (IhOu 7), Dog River Cabins I (IlOv 4) and II (IlOv 5), and the Pelican Portage camp (IlOv 2).

Smoky

Only one significant site has been noted on the Smoky River as of January 31, 1993. The Smoky River Buried Campsite (GaQs 1) is located in the headwaters of the Smoky River. This site has a very long prehistoric record. Very early sites (Early Prehistoric Period) have been found in the greater Grande Prairie region and may be associated with the Smoky River.

South Saskatchewan

The South Saskatchewan River has a good prehistoric record, although historic settlement along the river has been limited. At least 13 significant sites have been recorded on the river, including several prehistoric ceremonial sites. A cluster of five significant sites was noted just downstream from the confluence of the Bow and Oldman. These sites consist of the Laidlaw Antelope Trap (DlOu 9), Wallwork Site kill and camp (DlOu 7), the Grassy Lake Cairn (DlOv 1) and Grassy Lake Medicine Wheel (DlOv 2), the Murphy Medicine Wheel (DlOw 6) and the Grand Forks Whiskey Post (DlOw 8). The Suffield Medicine Wheel (EaOs 2) occurs further downstream. The Medicine Hat area has at least four significant sites, including three buildings within the historic downtown and the Medicine Hat N.W.M.P. outpost (EaOp 11). Beyond Medicine Hat, three sites of significance are the Mitchell Bluff Burial (EaOp 13), the Ellis Medicine Wheel (EcOp 4) and EdOm 2, a campsite and medicine wheel.

3.3.2 Summary of Human Heritage Values Assessment

The following identifies a summary assessment of "A" and "B" rivers according to how well they reflected specific human heritage value integrity guidelines. Those having few,. if any conflicts with human heritage integrity values were categorized as an "A "category river. Those having some conflicts or concerns with particular human heritage integrity guidelines were categorized as "B" rivers. Map 3 illustrates the "A" classification rivers.

"A" Rivers:

Athabasca - Segments 1 and 5

Belly

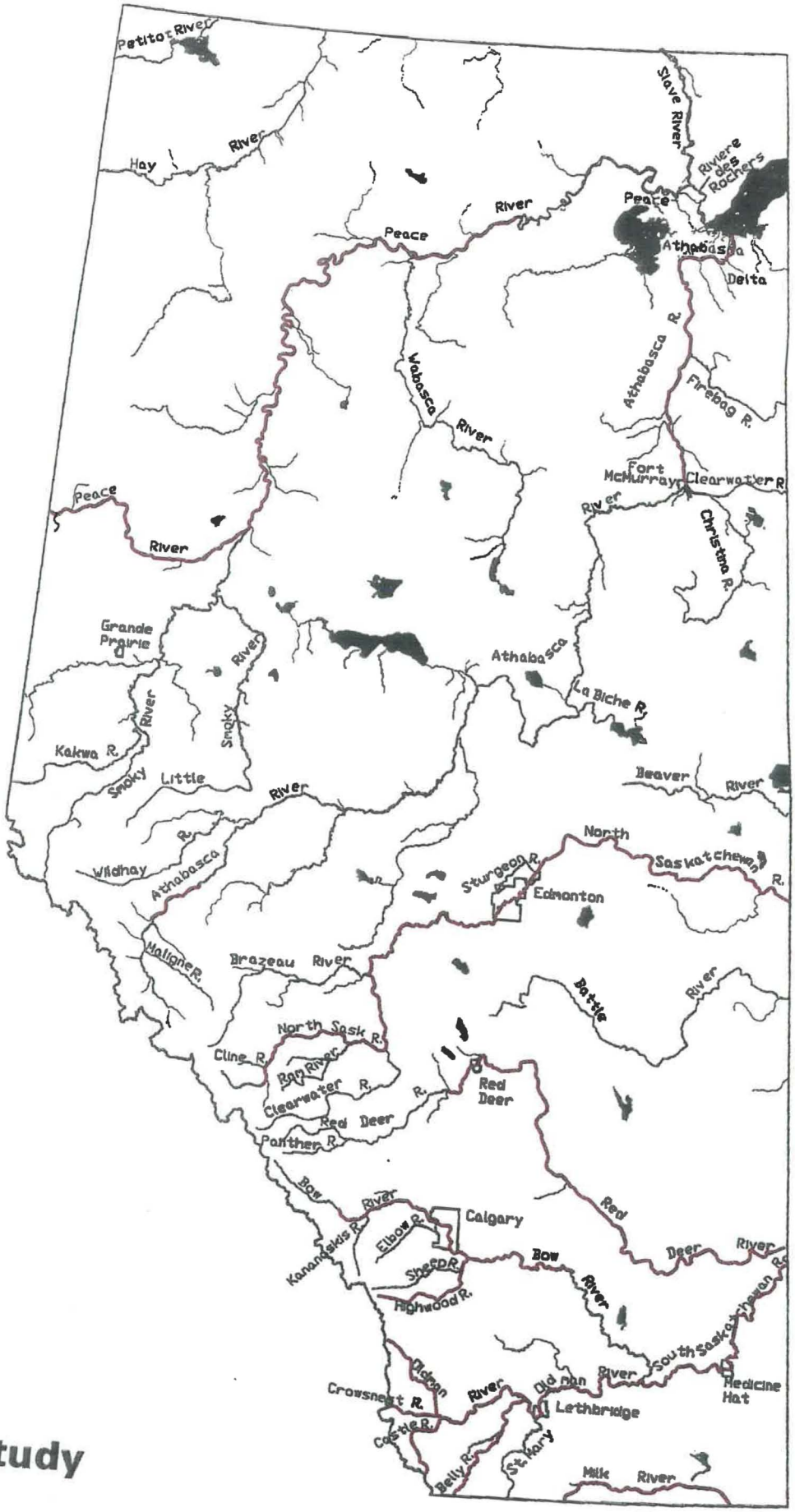
Bow - Segments 1, 2 and 3

Castle

Crowsnest

Map 3

"A" Rivers for Human Heritage Integrity



Alberta
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Highwood

Milk

North Saskatchewan - all segments

Oldman - all segments

Peace - all segments

Red Deer - Segment 2

South Saskatchewan

3.4 Recreation Integrity Values

Recreation use of a river can cover a wide range of activities from passive, indirect activities like nature study or nature viewing to direct, active use such as whitewater kayaking or fishing. Recreation use or appreciation of Alberta rivers occurs across the province, the problem is in measuring such use. The most useful measurement is provided from river trip cards which are returned to the government on an annual basis which allows resource managers to track certain types of river use (i.e. kayaking canoeing, fishing etc.). User groups and river enthusiasts provide additional information for determining the extent of river recreation use.

However, most recreation activities can be influenced or effected by such factors as; low water levels, excessive pollution, limited public access to river course. These criteria were generally evaluated in Phase 2. So, in assessing river recreation integrity, a criteria needed to be identified that could be broadly applied. The following was determined.

- The river should possess water of a quality suitable for those recreational opportunities for which it is nominated (primarily non contact recreation).

Several CHRS studies did not assess river integrity for recreation use because they felt recreation use was not of heritage value. However, in this evaluation, it was felt that recreation use or the significance of recreation use on a particular river could serve as a "deal maker" in deciding how a certain river would be classified in the final analysis. It was also felt that those rivers which support a wide range of public use be it on the river or adjacent to it (as in the many river oriented urban parks which Alberta cities have developed), such use could be seen as providing strong public support for the possible nomination of that river to the CHRS system.

3.4.1 Recreation Integrity Assessment

The following provides an overview of how the short-listed rivers and their river reaches were evaluated in terms of meeting recreation integrity.

Athabasca

The Athabasca River overall rated quite high for recreation use because of the diversity of activities that take place on the river from whitewater boating to power boating to trail related activities alongside the river and the diverse landscapes and scenic opportunities found along the river. However, the river is also effected by several pulp mills and other industrial activities which reduces its overall integrity values.

S1. Jasper Park Boundary to Hinton

Has some canoeing and scenic landscape values, but this section is not heavily used. The portion upstream within the National Park receives more use from river rafting etc.

S2. Hinton to Whitecourt

Jet boating, some canoeing, but limited access and influenced by pulp mill at Hinton. Users have complained of water pollution and odours when using this reach.

S3. Whitecourt to Athabasca

Jet boating, canoeing, some shoreline activities near communities including campground access, but reach is influenced by forestry and pulp mill activities.

S4. Athabasca to Fort McMurray

This section has a popular jet boat attraction, the Big Bend area and historic trails to attract recreation users. This section also influenced by forestry industry activities that can compromise certain recreation use but open up others.

S5. Fort McMurray to Lake Athabasca

Some jet boating, outfitting. Natural and landscape appreciation near delta area and Lake Athabasca is high, but area is relatively remote and is also influenced by Oil Sands production facilities.

Battle

This river did not score very high for recreation values primarily because of its limiting flow regime and heavy agricultural uses affecting recreation experience.

Beaver

The Beaver River offers some power boating and flatwater boating opportunities. While it has some natural features they were not considered outstanding. The river is also influenced by strong contemporary landscape of urban /agricultural uses.

Belly

While the Belly River does have associated river recreation activities on it, the river is more noted for its heritage and natural landscape values which gave the overall river a strong recreation score value. However, the river is influenced by various dams, weirs and agricultural practices which may compromise recreation experiences.

Bow

The Bow ranked as one of the highest rivers for recreation activity including a wide range of canoeing, whitewater and rafting opportunities. It is also internationally known for its trout fishing. However, the river is heavily influenced by various dams, urbanization and water quality concerns below Calgary which does affect overall integrity.

S1. Canmore to Morley

Various canoeing, boating activities and fishing. Access from various points along the Trains Canada Highway #1 and 1A. Influenced by industry, highway, railway, and weirs on river.

S2. Ghost Dam to Bearspaw

Some use including wind surfing / boating activities on reservoir. Industry influences.

S3. Calgary to South Saskatchewan River

This section has renowned trout fishing (in part from the nutrient rich waters produced from Calgary discharges) and various boating activities. The water quality in this section is being improved and is felt to be in a manageable condition.

Brazeau

This river has excellent whitewater boating opportunities and high values for natural landscape appreciation contributing to a strong recreation assessment. The river also has high water quality, but is somewhat remote with limited facilities to support extensive recreation use and is influenced by a major dam.

Castle

This river scored high for recreation use opportunities focusing mostly on such factors as; excellent water quality, natural landscape features and strong trail related activities, hunting, fishing and camping. At this time, the river has no major encumbrances effecting river recreation integrity.

Clearwater (Athabasca)

This river has excellent jet boating and river tripping opportunities. It also offers a high degree of natural landscape values and a strong remoteness factor giving users a wilderness type experience away from crowded cities or man influenced areas. This river ranked 8th overall for recreation values.

Clearwater (North Saskatchewan)

This river ranked 9th overall for recreation values, particularly for such activities as whitewater boating and fishing. The river also has high natural values and high water quality.

Crowsnest

This river ranked 7th overall for recreation values being strong for whitewater boating, fishing and its natural features. However, the river is highly influenced by adjacent urbanization and industry compromising some of its integrity values.

Elbow

This river received moderate recreation score values and is influenced by the Glenmore Dam and heavy urban use. Yet the upper reaches are popular for whitewater boating and fishing. In the urban area the city receives trail use and some canoeing.

S1. Above Glenmore Reservoir

Good whitewater and fishing opportunities

S2. Below Glenmore Reservoir

Limited use.

Highwood

This is a popular whitewater boating and fishing river with high natural values and high water quality. There are no major encumbrances affecting river integrity. The river ranked 3rd overall for recreation values.

Little Smoky

This river has moderate flatwater and whitewater opportunities. It is not heavily used for recreation as such. It is also influenced by forestry practices.

Milk

Although parts of the Milk River does receive strong recreation use, most of the river is relatively inaccessible for recreation access and is affected by seasonal fluctuation in flow.

North Saskatchewan

This river ranked 11th overall for recreation values. It is heavily used for canoe tripping and the river valleys through the various communities it flows are well developed for river recreation use and access. However, the river is also influenced by industrial factors and water quality factors downstream of Edmonton.

S1. Banff Park Boundary to Abraham Lake

There is limited use in this segment. Abraham Lake can be a dangerous site for boating activities.

S2. Bighorn Dam to Fort Saskatchewan

This is the most popular segment for recreation use with numerous opportunities to access the river. Apart from the influence of the dam, the river is relatively unencumbered in this section.

S3. Fort Saskatchewan to Saskatchewan Border

This section also receives some flatwater and power boating use but is influenced by water quality factors reducing its overall river integrity.

Oldman

The Oldman is well known for its whitewater and flatwater boating opportunities.

S1. Above the Oldman Dam

This segment is relatively unencumbered and has strong natural values and excellent whitewater boating opportunities.

S2. Below Dam

This segment receives extensive flatwater and some power boating use, but is influenced by agricultural and urban development in addition to the Oldman Dam.

Peace

The Peace River ranked 4th overall in terms of recreation value. It is a large river offering a wide range of river recreation opportunities including, power boating, flatwater boating, fishing and has high scenic and natural values. However, the river is somewhat remote and does not receive heavy recreation use.

S1. Above Peace River (town)

The upper reaches offer relatively gentle flatwater and power boating opportunities and is popular for sport fishing.

S2. Below Peace River (town)

The lower reaches provide more challenging whitewater. This section also contacts Wood Buffalo Park, which offers a rich natural diversity.

Red Deer

The Red Deer ranked as the number 1 river for recreation values and overall offers the widest diversity of recreation opportunities from international whitewater kayaking to leisurely flat water canoe tripping through the world famous dinosaur sections of the river. In addition, the city of Red Deer has developed a world class urban park setting alongside the river .

S1. Banff Park to Glenifer Lake

This section contains the world class whitewater course and is noted for its natural landscape qualities and relative natural state.

S2. Below Dickson Dam

Although the dam influences the river in this section, this is the most heavily used portion of the river from a recreation use perspective and also contains the internationally significant Drumheller Valley.

Sheep

The Sheep River ranked second overall and is noted for its whitewater, its scenic landscape qualities and general natural state of conditions with no encumbrances affecting integrity values.

Slave

The Slave River has some recreation values but its remoteness and limited access restricts heavy recreation use.

Smoky

The Smoky offers some recreation opportunities but its relative remoteness, limited access and forestry influences limits it overall recreation appeal. However, the river is internationally known for its annual jet boat race.

South Saskatchewan

This river receives some power boating and flatwater use but is influenced by impoundments and water quality factors. The river through Medicine Hat offers excellent recreation access and opportunities.

3.4.2 Summary of Recreation Integrity Assessment

In evaluating recreation integrity, two categories were identified. Class "A" representing rivers or river reaches having true, 100 percent integrity for river recreation use, or having such high potential for use that potential encumbrances do not diminish recreation experiences.

Class "B" rivers are those rivers or river reaches which technically do not meet recreation integrity guidelines (i.e. due to water quality, dams, etc.) but because of extensive recreation opportunities represent a significant factor in a river's final assessment. Class "B" rivers included primarily those reaches through various urban park settings.

The following Table summarizes our evaluation of those rivers meeting class "A" or "B" status for recreation integrity evaluation.

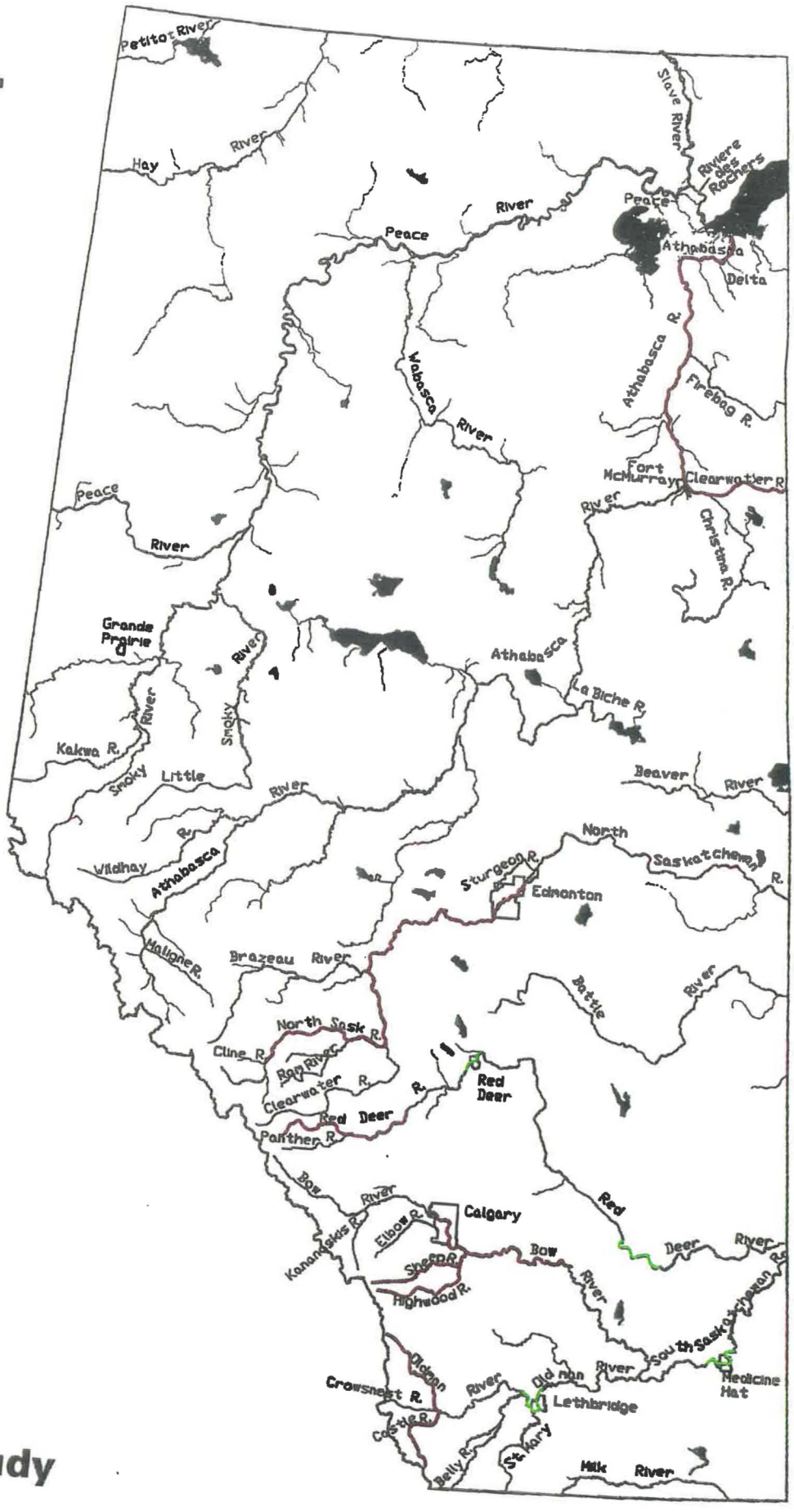
In evaluating recreation integrity two classifications were identified. Class "A" representing rivers or river reaches having true, 100 % integrity for river recreation use. Class "B" which technically does not meet recreation integrity guidelines but because of extensive recreation use opportunities does represent a significant factor in a river's final assessment.

Map 4 illustrates the Class "A" rivers and river segment.

CLASS A	**CLASS B**
Athabasca - Segment 5	Oldman -Segment through Lethbridge
Bow River - Segment 3	South Saskatchewan through Medicine Hat
Castle	Red Deer through Red Deer and Drumheller
Highwood	
North Saskatchewan - Segment 2	
Oldman - Segment 1	
Red Deer - Segment 1	
Sheep	

Map 4

"A" and "B" Rivers for Recreation Integrity



Legend*

"A" Rivers

"B" Rivers

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4.0 MANAGEMENT FEASIBILITY ASSESSMENT

4.1 Background

With an assessment of each river's general integrity within each heritage theme category completed, a further assessment is undertaken to review each river or river reach for their potential for sound management as a heritage resource. Manageability is assessed within the context of jurisdictional policies, land use, local development support, access, tourism and a host of other relevant issues.

This step included reviewing all pertinent legislation that could effect river management and identifying a number of management assessment criteria potentially affecting each of the short-listed rivers.

4.2 Legislative and Other Options Pertinent to Heritage Rivers Management

The Canadian Heritage Rivers System program (CHRS) itself does not provide any legislated protection to rivers or their adjacent lands. If rivers which possess recognized natural, historical or recreational values of national significance are to be preserved, additional legislative protection may be needed beyond existing federal and provincial legislation.

Existing legislation provides varying degrees of protection to rivers in a fashion consistent with the values of the Canadian Heritage River System. This includes both Alberta Provincial Acts and Federal Acts.

4.2.1 Provincial Acts

Six Provincial Acts have the potential to protect CHRS rivers. These are briefly described below.

The Public Lands Act: Rivers which flow through public lands fall under the management of the Public Lands Act. This act, administered by Alberta Agriculture, Food and Rural Development, gives the Minister the authority to classify public lands and plan for their use.

The Public Lands Act has been used to establish a variety of land classifications with different intensities of land use. Since 1971, this Act has been used to designate sections of public lands as natural areas. Natural areas are sections of public land which possess some or all of the following characteristics:

- scenic, unique or sensitive characteristics
- diversity of plant and animal habits
- may provide viewing or recreational opportunities

Designation as a natural area gives the Minister the power to specify permitted and prohibited activities. The Minister can exercise this power to define activities which would be consistent with the goals of the CHRS.

The Wilderness Areas, Ecological Reserves and Natural Areas Act: Passed in December 1981, this Act was created to administer natural areas. Additionally, the Act created a new classification: ecological reserves, as a more refined protection mechanism. Different levels of protection were made available under this legislation depending on the designation.

Designation as a wilderness area is intended to manage and preserve animal and plant life in the area and prohibits vehicles, hunting, fishing, aircraft, littering and removal of plant life.

Ecological reserves are intended to protect areas based on ecological or scientific interest.

Designated natural areas are sites requiring special management attention but do not automatically pose any restrictions on use.

Provincial Parks Act: The Provincial Parks Act gives the Minister of Environmental Protection the power to both establish parks and recreation areas and regulate the uses of land resources or water within these areas. The purpose of this act is as follows:

> *3. Parks shall be developed and maintained*
>
> *(a) for the conservation and management of flora and fauna,*
>
> *(b) for the preservation of specified areas and objects therein that are of geological, cultural, ecological or other scientific interest, and*
>
> *(c) to facilitate their use and enjoyment for outdoor recreation*

In the history of the CHRS, precedents have already been set at both the provincial and the federal levels. Saskatchewan's Canadian Heritage River, the Clearwater, enjoys the benefits of both CHRS designation and Provincial Park protection. The Clearwater River Provincial Wilderness Park is Saskatchewan's largest provincial park.

Similarly, under Federal jurisdiction, the river reaches of the Athabasca River and the North Saskatchewan River within Alberta's Jasper and Banff National Parks already possess CHRS designation and are provided protection under the National Parks Act.

The Willmore Wilderness Park Act: The Willmore Wilderness Park Act is an example of legislation dedicated to the establishment of a specific special place.

Passed in 1963, the Willmore Wilderness Act did not prohibit industrial activity. Instead, a management strategy governed the parks administration with mining activities and boundary changes allowed at the discretion of the Alberta Cabinet.

The park's boundaries have been changed twice to accommodate mining interests, however, the Government of Alberta has changed the act to outlaw industrial development in the Willmore Wilderness as part of its Special Places 2000 Policy Program.

Legislation similar to the Willmore Wilderness Act could be passed to protect a Canadian Heritage River.

Water Resources Act: Despite the increasing demands on water resources in Alberta, the legislation governing its use has not significantly changed since 1931. In July of 1991, the government of Alberta initiated a review of Alberta's water management policies and legislation.

While the principal focus of the Water Resources Act is managing its use for domestic, industrial and agricultural use, the issue of "instream flow" needs was an important issue during public hearings on the forthcoming changes to the legislation. Instream flow refers to the volume of water which must be left in a river for the purpose of conservation, recreation or the propagation of riparian vegetation and wildlife, as well as water quality requirements.

The draft Water Resources Act contemplates a licensing process by which ecological qualities of a river might secure protection in a fashion consistent with the objectives of the CHRS.

The Historical Resources Act: With human heritage as a major theme of the CHRS program, the Historical Resources Act could act as another tool for awarding extra protection to a designated river. The Historical Resources Act (revised 1980, 1987) defines historic resources within the Province of Alberta and delineates the role of the Minister responsible for administration of this legislation. Historic resources include any work of nature or of man that is primarily of value for its palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest including, but not limited to, a palaeontological, archaeological, prehistoric, historic or natural site, structure or object. The Minister is responsible for the orderly development, preservation, study, interpretation, and promotion of appreciation of historical resources within the Province of Alberta. Thus, the Minister has the authority to acquire, designate and protect historical resources considered to be in the public interest. Along with details of regulation and administration of historic resources, the legislation establishes the Alberta Historical Resources Foundation and also defines the penalty for willful contravention of the Act. The ministry responsible for regulation of this legislation is Alberta Community Development.

The Act gives the Minister of Community Development the power to designate and protect the historic resources of the Province. Provincial Historic Resources which may be established under this act include prehistoric sites, natural features and significant structures.

Alberta Environmental Protection Act: This act, which was passed in 1992, provides another means of protection for potential CHRS rivers in Alberta. The Environmental Protection Act takes an integrated approach to the protection of air, land, and water by consolidating a number or previous acts (i.e. Clean Air Act, Clean Water Act, Ground Water Development Act). Under this legislation, any current or proposed developments pertinent to rivers require environmental assessments to identify potential negative impacts. This act also ensures public involvement in any decisions that may influence rivers. The Environmental Protection Act has provisions to penalize responsible environmental offenders, thereby enhancing the protection of rivers from serious impacts.

4.2.2 Federal Acts

Several Federal Acts may also assist or complement Provincial legislation in the protection and management of CHRS rivers (from Island Nature Trust, 1991).

Department of Environment

Canadian Environmental Protection Act: This Act is administered by the Minister of the Environment and provides a framework for protection of Canadians from all forms of pollution caused by toxic substances. The Act improves the federal government's ability to manage chemical substances and covers development, manufacture, transport, distribution, use, storage and disposal of such substances.

Canada Water Act: This Act sets the stage for administrative cooperation between the federal government and provinces on water resources and water quality management and provides a firm basis for federal initiative in the absence of such cooperation. The Governor-in-Council may prescribe substances as waste, prescribe procedures to be followed by agencies in determining their recommendations to treatment changes and water quality standards.

Canada Wildlife Act: Under this Act the Minister may undertake such activities as: (a) the promotion or recommendation of measures for encouragement of public cooperation in wildlife conservation and interpretation and (b) coordinate and implement wildlife policies and programs in cooperation with provincial governments. Lands may be acquired for wildlife research, conservation or interpretation. Regulations outline general prohibitions (i.e. swimming, hunting, fishing, picnicking, camping, boating, littering, etc.) which prevent any disturbance of habitat in wildlife areas. Also this Act prevents persons from damaging or disturbing soil, vegetation or artifacts. The Minister may designate any area as a wildlife reserve.

Historic Sites and Monuments Act: The Minister may, by means of plaques or other signs, mark or commemorate historic places. The Minister may also provide the administration, preservation and maintenance of any historic places acquired pursuant to this Act. The Act also established the Historic Sites and Monuments Board of Canada which considers, among other things, recommendations respecting marking, commemoration, administration, preservation and maintenance of historic places and historic museums.

National Parks Act: This legislation was established for the arrangement and control of National Parks. The Governor-in-Council may make regulations for protection of fish and prevention of obstruction or pollution of waterways, for using and disposing of mineral waters for recreational and therapeutic purposes and for establishment of domestic water supply and sewage services.

Migratory Birds Convention Act: This Act is administered by the Canadian Wildlife Service of the Department of the Environment. Designed for protection of migratory birds, the act provides for habitat acquisition and for establishment of wildlife areas. It also prohibits the deposit of any substance harmful to migratory birds in any waters or in any area frequented by migratory birds. Although this Act mostly relates to lakes, it could also apply to important staging areas located on rivers.

Department of Fisheries and Oceans

Fisheries Act: The Fisheries Act controls the fisheries of Canada. Section 33, administered by Environment Canada, restricts the release of "deleterious substances" to river waters. As well, provisions for fishways (Section 20) and fish habitat (Section 31) would have application and are under the administration of Fisheries and Oceans Canada. The Act states that no person shall carry on any work or undertaking that results in harmful alteration, disruption or destruction of fish habitat. Fish habitat is defined as spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly for survival.

Department of Transport

Navigable Waters Protection Act: This act is administered by the Ministry of Transport and enables the Minister to control construction of works in navigable waters including bridges, booms, dams, wharves, docks, piers, tunnels, pipes and other associated works which might interfere with navigation. The Act and its regulations are principally concerned with the flow and depth of water for navigation purposes.

4.3 River Management Issues

The management feasibility of the 22 rivers was evaluated with the realization that heritage river management is a very complex issue. The management considerations were grouped into nine general categories:

Physical Characteristics, Industrial Land-Use, Industrial Water-Use, Hydrological Development, Urbanization/Development, Recreation and Tourism Development, Historical Resource Sites, Protected Areas and Management Complications. Within each category, there may be one or more sub-categories. For example, the category of Physical Characteristics was comprised of the sub-categories of Water Quantity and Quality.

Each management issue pertinent to the river in question was generally evaluated for its potential impact on the manageability and ecological integrity of the river or river segment.

Management Issues:

The following management issues were investigated (see Appendix I for specific guidelines used to evaluate each river):

4.3.1 Physical Characteristics

Both water quantity and quality were considered to have important management implications.

Water Quantity

High volumes of water reduce the risk of negative impacts from industrial or agricultural water use, hydro-electric development and help dilute and flush out contaminants. Sufficient water levels are also beneficial for recreational use. Rivers that have large discharge rates (e.g. Peace and Slave) received high positive scores, while those with reduced discharge rates (e.g. Battle and Milk) received low positive scores. It was assumed that rivers with restricted flow problems generally would be more difficult to manage.

Water Quality

Water quality is an important factor in assessing the integrity of the human heritage, natural heritage and recreation themes. Poor water quality was judged to be detrimental to river management because of expensive and complicated remedial measures that would be required to restore the river's integrity. The river received a negative score if restoration of water quality was deemed necessary to meet integrity guidelines. High water quality was assumed to have a beneficial impact on the manageability and ecological integrity of the river and therefore received a positive score.

4.3.2 Industrial Land-Use

This category is synonymous with the "economic land-use" term used in the Newfoundland CHRS study (Halfyard, 1987). In Alberta the most important land resource-based industries are forestry, agriculture, oil and gas extraction and mining. All of these economic land-uses can have negative impacts on river management and can be detrimental to river integrity.

Forestry

Forestry is a rapidly expanding industry in Alberta and may produce management constraints on rivers. Forestry practices may increase soil erosion in the watershed and degrade water quality (Swanson, 1992) and modify wildlife habitat. Associated pulp and paper mills also reduce water quality (see Industrial Water-Use section). Clear-cuts placed adjacent to rivers will decrease their recreation value temporarily by reducing aesthetics. On the positive side, forestry roads may enhance recreational use of rivers by increasing their accessibility.

The relative impact of forestry practices on river management was estimated by the proportion of the river passing through lands available for forest harvesting. Due to time constraints, it was not possible to investigate the management practices of each Forest Management Agreement holder or quota holder. In some cases it should be noted that forestry practices are being modified in a way that can lead to better management of river resource values.

Agriculture

Agricultural activities, like forestry practices, may reduce the heritage river management rating. Intensive agricultural practices tend to be detrimental to rivers by increasing soil erosion and decreasing water quality (e.g. nutrients and pesticide run-off). Cultivated or grazed lands adjacent to rivers and river banks may reduce aesthetics and could degrade riparian wildlife habitat.

Although cultivation may have different impacts than grazing activities, it was not possible to distinguish between these two practices within the time-frame of this study. The intensity of agricultural use was judged by actual and potential use, with the rivers rated by the proportion of surrounding land that was agricultural or available for agricultural development.

Again, like forestry, certain agricultural practices might actually add to a rivers integrity evaluation and management capability, especially in instances where it reflects a certain human heritage value (i.e. the river lot farming along the Sturgeon and North Saskatchewan)

Oil

Unlike most other provinces, oil-related activities play a dominant role in the economy of Alberta and will continue in the future. Much of the province is covered by oil fields or oil sands. Oil-related activities involve the exploration, extraction, transport and processing of petroleum. The establishment of oil wells is associated with increased development of seismic lines, roads, power lines,

pipelines and related structures. However, these developments may not be detrimental if placed at a sufficient distance from river valley breaks. Oil wells and oil sands processing also represent a serious threat to water quality and river integrity. Oil development generally conflicts with heritage river values and therefore was assessed to have a negative impact. On the positive side, recreation opportunities may increase through greater river access due to oil road construction.

The severity of oil-related impacts was determined by the proportion of the river traversing oil fields or oil sand deposits, and therefore does not take into account any future oil discoveries in this province.

Gas

Gas-related activities produce similar problems as oil-related activities for heritage river management. In addition, gas plants located near rivers decrease landscape appreciation and their emissions may cause some local ecological damage.

The potential negative impacts from gas activities were gauged in the same manner as oil: the proportion of the river which intersects gas fields.

Mining

Most of the mining activity in Alberta is concentrated on coal. Other important minerals include salt, silica, bentonite and sodium sulphate. The severity of mining impacts varies depending on whether it is an open-pit or underground mine and on its location relative to the river. Besides the detrimental effects on the landscape, there are also the concerns of water and air quality degradation associated with mines.

Mining was rated by the number of mines on or near the river. Due to the importance of coal in Alberta, the proportion of the river traversing coal beds was used as a second factor to gauge possible future developments.

4.3.3 Industrial Water-Use

Water utilization by industry places a large demand on the water resources of rivers. The most significant users include the pulp and paper industry, food and beverage industries, chemical industries and oil sands development (Thompson and Lennon, 1992). The greatest impact of industrial water-use are the potentially toxic discharges produced and subsequent degradation of water quality. Dioxins and furans produced by pulp and paper mills and contamination

from oil sands processing are examples of some of the concerns that diminish the integrity of the river.

Rivers were rated for industrial water-use by the estimated impact of the various industries that directly utilize and impact their water resources.

4.3.4 Hydrological Development

Water in rivers is used directly to generate electricity and for irrigation. Dams and canals are created to store or divert water for these purposes. These types of river developments will have severe impacts on river processes because they produce direct changes to the hydrology of the river. Three related sub-categories (dams, generating stations, irrigation use) were investigated.

Dams

In Alberta, dams are constructed for hydro-electricity generation, irrigation and flow regulation. The impoundments created by dams produce several effects which are incompatible with CHRS guidelines (Halfyard, 1987). Flow in the river channel is changed and therefore natural river processes are interfered with. River channels and plant and animal habitats may change drastically, and river movement may be disturbed due to changes in flow. Both recreation-users and aquatic life are physically impeded by dams. There are also concerns about possible mercury contamination. On the other hand, flow augmentation associated with dams may help dilute polluted waters and provide water for recreation in the late summer. Dam construction may have some other positive effects on recreation use by creating artificial lakes and enhancing fisheries (Haskin, 1992).

The impact of dams was rated by the number of dams present on the river, rather than the proportion of the river impounded, since the actual impoundment lengths are generally insignificant compared to river length. Dams on tributaries and on the river outside of the province were also taken into account.

Generating Stations

The two main types of electrical generating stations are hydro-electric and thermal. The former is usually associated with dams, whose impacts were dealt with in the previous sub-category for dams.

Generating stations and their associated transmission structures may degrade the natural beauty of the river and can be hazardous to fish and wildlife.

Thermal power water utilization represents the second largest water use in Alberta, although 95% is actually returned to the river (Thompson and Lennon, 1992). Thermal power plants may cause "thermal pollution" by increasing the river temperature above natural levels. This heated water may be beneficial to waterfowl by maintaining portions of rivers open during the winter. However, this may be hazardous to the public as a result of poor ice conditions on rivers and could disturb aquatic ecosystems.

The influence of generating stations was assessed according to the number of hydro-electric and thermal power plants present on the river.

Irrigation Use

Irrigation accounts for the vast majority (90%) of water consumed in Alberta (Thompson and Lennon, 1992) and is currently only a management issue in Southern Alberta. Water from rivers is impounded and diverted into canals which convey water for irrigation. Impacts from the trapping and diversion of water can be tremendous, often resulting in only a fraction of the normal flow downstream. Reduced water flows have been documented to be detrimental to cottonwood forests in southern river valleys (Rood, 1990). On the positive side wetlands and waterfowl habitat has been created by some irrigation projects (Webber, 1992).

The impact of irrigation use on rivers was judged by the number of canals and the amount of water consumed by irrigation practices related to the river.

4.3.5 Urbanization/Development

Urbanization and linear development (roads, transmission lines, pipelines, etc.) present serious problems for river management and compromises many of the river heritage values. High population concentrations put greater strains on the river's resources. Industrial and municipal water uses consume water and seriously jeopardize water quality, while development of roads, bridges and buildings degrade the natural scenic values. Some developments can create urban scenic values, while development of transportation corridors may increase access to the river, potential overuse by recreationists (e.g. erosion of trails) may cause ecological damage, unless trails and recreational facilities are carefully developed and managed as in many of Alberta's river oriented urban parks.

Roads/Railways

Transportation corridors adjacent to rivers, while they may afford a scenic view to travelers, may not be aesthetically pleasing to river users. Roads and railways built too close to shorelines may also cause bank erosion and transportation corridors also pose a serious hazard to wildlife. Most linear development along rivers is due to urban influences, although some remote sections of rivers may have nearby roads and railways.

The relative impact of roads and railways was estimated by the proportion of the river that had adjacent roads, railways or urban development.

Bridges and Ferry Crossings

Bridges, like parallel roadways, diminish the natural quality of the landscape. The placement of pillars to support bridges impedes water flow, often creating treacherous conditions for boaters. Bridges and their associated structures may also impair migration of wildlife that utilize rivers and valleys. Ferry crossings may cause similar problems.

The relative effect of river crossings was determined by the concentration of bridges and ferry crossings (number of crossings per river length) on the river.

Transmission Lines

Transmission lines pose an aesthetic problem similar to that of bridges. Electrical lines are also a hazard to birds.

The concentration of transmission line crossings was measured in a similar manner as bridges were (average number of intersects per river length).

Pipelines

Oil and gas pipeline crossings of rivers are common in Alberta, traversing both rural and urban settings. Pipelines are a threat to a river's integrity, because they increase the probability of contamination due to leaks or ruptures.

The concentration of oil and gas pipeline crossings was measured in the same fashion as bridges and transmission lines (average number of intersects per river length).

Population Concentration

Population concentration along a river can provide an approximate measure of a river 's potential resource use and appeal. High populations along the river corridor can exert a negative impact on the river because of increased water consumption and possibility of contamination. The urbanization of river valleys also increases recreation use, however it may diminish the "natural experience" sought after by many users.

The population concentration was measured by the total number of people living in population centres "near" the river, divided by the river length. A city, town or village was considered "near" if it was located on the river or within 2 km of the shoreline.

4.3.6 Recreation and Tourism Development

Recreational and tourist utilizations of rivers are beneficial to river management because they generally require the conservation of heritage values. Recreation and tourism use are usually dependent on the quality of the river resource and to the degree of development of the infrastructure.

Although the development of the recreation opportunities may often conflict with natural heritage values, it is generally believed to have an overall positive influence on the management of heritage rivers.

Provincial/National Parks

Provincial and National Parks are public recreation areas that are regulated by provincial and federal legislation. Generally these parks protect the resources that are attractive to visitors and often provide infrastructure (e.g. trails) for recreational use.

In rating rivers for provincial and national parks, the number of parks that come in contact with the river was used as a criterion, thereby reflecting the diversity of recreational themes and opportunities.

Recreation Areas

Recreation areas are those designated primarily for recreation use, with hiking, canoeing, fishing, hunting and scenic viewing as the prevailing activities.

The proportion of the river included in recreational areas or proposed recreational areas was used to rate this factor. Proposed recreation areas were

down-weighted to half the score of existing recreation areas due to the uncertainty of whether they will actually be established.

Campgrounds

Camping opportunities are an important recreation component along rivers since they often allow the user to experience the river's natural values. A variety of recreationists also tend to utilize campgrounds including: anglers, hunters, canoeists, kayakers, hikers, bird-watchers and vacation campers.

Campgrounds also present a means of controlling the use of the river by limiting the number of campers and confining them to certain "less sensitive" areas.

A very high concentration of campgrounds can have a negative impact on the river by reducing the natural aesthetics of the river environment, however campgrounds are considered to have low impacts compared to urban development and were rated as positive for management.

Rivers were rated for campgrounds by their concentration of campgrounds (number of campgrounds per length of river).

4.3.7 Historic Resource Sites

Previously recorded historic sites are important indicators for the human heritage theme for nominated rivers which can be considered positive management factors. The presence of recorded historic sites provides a means of protection through provincial legislation.

The ratings of rivers for historic resources can be determined by the number of recorded significant sites and areas (cultural sites/areas only) located on or directly adjacent to the river, based on the *Significant Sites and Areas Listing* produced by Alberta Community Development, Historic Sites and Archives Service.

4.3.8 Protected Areas

Protected areas include areas which are legally designated wilderness or which are designated for the protection of their natural heritage values. These include lands generally protected from industrial developments (e.g. forestry or agriculture) and heavy recreational use such as motorized travel.

Areas that fall into this category include National Parks, Provincial Parks, Wilderness Areas, Ecological Reserves, Conservation Natural Areas and National Wildlife Refuges. National and Provincial Parks were included in this category because they are supposed to be legally protected, even though some are threatened by over-development (e.g. Banff) and were historically logged (e.g. Wood Buffalo).

The protected area score for each river reflects the proportion of the river that passes through these areas. Proposed protected areas received half the weight of existing protected areas due to uncertainties as to whether they will gain protective status in the future. For instance, if 30% of a river falls into a proposed Ecological Reserve, it was down-weighted to a value of 15%.

4.3.9 Management Complications

This category includes land jurisdiction and political factors that may impact management decisions. These include land tenure, government jurisdictions, parts of rivers which are not in Alberta and Integrated Resource Planning (IRP).

Land Tenure

Land ownership has a significant impact on the manageability of heritage rivers. Federal or Provincial crown land will tend to have fewer management constraints than private land, unless it is leased to specific users (i.e. grazing). Protective legislation is easier to apply to land under government control than on private land.

For rating land tenure, the greater the proportion of private land adjacent to the river, the more severe the management impact. For purposes of this study, land in cities, Indian Reserves and Metis Settlements was considered to be private land.

Jurisdictions

The rivers in Alberta flow through a variety of government jurisdictions, including National Parks, Counties, Municipal Districts, Special Areas, Indian Reserves, Metis Settlements, Military Reserves and cities.

Political agendas and legislation may vary from district to district, therefore, management decisions on the whole river may be difficult to apply. It is assumed that the negative potential for river management increases in conjunction with an increase in the number of jurisdictions through which the river passes.

Interprovincial/International

Rivers often cross political borders, therefore some management problems of Alberta rivers may originate in the United States or other provinces. Impacts beyond Alberta's borders are difficult, if not impossible to control (e.g. WAC Bennett Dam in British Columbia). This adds an intangible management factor into the assessment equation.

Rivers originating, or with tributaries outside of Alberta are vulnerable to this management dilemma and therefore received negative ratings for the International/Interprovincial sub-category. If the river was protected outside of Alberta, the management impact was considered to be less severe. Rivers that flow from Alberta to another political jurisdiction were also suspect (i.e. South Saskatchewan, Red Deer), however downstream impacts were assumed to be less severe than upstream ones and therefore they received a lower negative rating.

Integrated Resource Planning (IRP)

Integrated Resource Plans (IRPs) are the framework through which the Provincial Government of Alberta prioritizes and manages the allocation, development and conservation of resources on Crown lands. This is done at the regional, sub-regional and local levels, whenever a need to implement such a plan is deemed necessary - for example, whenever conflicting interests arise in the use of specific areas and their resources. IRPs, where they exist, represent government policy in the areas they manage, and as such are a very strong indicator of present and future development intentions, and whatever commensurate protective measures may also be entailed. The one drawback to the use of IRPs in rating the protective values of Alberta rivers for potential CHRS status is that many rivers pass in part through areas for which there is no IRP currently in place.

Zoning - Each IRP designates zoning of areas for particular use(s): Prime Protection, Critical Wildlife, Special Use, Buffer, General Recreation, Multiple Use, Mineral Expansion, Agriculture, Industrial and Facility. Each river was evaluated based on the separate IRPs it flowed through and zoning designations along its banks within those IRPs. Zones that were considered more detrimental to river quality and therefore its protection, were those that were judged to allow more development, particularly in the area of industry. Conversely, zones that were considered beneficial were those that were judged to allow less development and maintained a more pristine state of the river.

IRP Quality (Breadth of Concerns and Depth of Description) - IRPs adhere to the same management objectives and guidelines. The relevant rivers that run through IRP areas were rated accordingly; with better (protective) ratings reflecting the specificity and breadth of an IRPs perceived mandate and the degree to which that mandate prioritizes water resources, thereby minimizing the environment impact of development on them.

A final rating was arrived at for each of the fourteen CHRS candidate rivers within the IRP system by combining the scores from each of the two evaluations (zoning and detail). The rivers which did not have any IRPs were rated negatively, except those where IRPs did not apply (i.e. within National Park), which were rated as positive.

4.4 Management Feasibility Assessments

Each of the 22 rivers was evaluated for management feasibility with brief descriptions of key management issues pertinent to the rivers described in Appendix 2. The rivers are presented in alphabetical order as follows:

Athabasca

The Athabasca river is the longest river in Alberta (approximately 1440 km) and it has a large number of management issues affecting it. One of the most serious management conflicts is related to the pulp and paper industry. With four pulp mills located on the main channel and one on a tributary, the Athabasca is the river most heavily utilized by the pulp and paper industry in Alberta. Although new technology and improved standards have reduced water-use by the industry in recent years, there is currently dioxin and furan contamination of fish throughout most of the river and some of its tributaries (Alberta Environmental Protection, 1995). Another management concern is the impact of forestry practices on the Athabasca, since nearly half of the river passes through Forest Management Agreement Areas. The oil and gas industries may also represent serious management constraints. Of particular concern is the oil sands production in the Fort McMurray area. As oil reserves throughout the world decrease, the oil sands resources will become increasingly developed, therefore the potential for contamination of the river will also increase. On the positive side, the Athabasca River has relatively high volumes of water and is still unimpeded by man-made impoundments. Sections of the river are protected in two National Parks and with a relatively large number of significant historic sites distributed throughout its course, parts of the Athabasca could be further protected through provincial legislation. Most of the land adjacent to the river is Crown land and the entire river is located within Alberta,

therefore management plans may be delivered effectively. On the negative side, the Athabasca passes through a large number of jurisdictions which will complicate the management process.

S1. Jasper Park Boundary to Hinton

Half of this segment passes through the Weldwood Forest Management Agreement Area, however, tree harvesting in this area has already been completed. Although population and development are low in this section, river access may be fairly high due to the proximity of transportation routes. Since this is a short segment (about 30 km), it has relatively few management complications and almost all the surrounding land is Crown. The relevant IRP (Coal Branch) appears to be beneficial for long term river management.

S2. Hinton to Whitecourt

The most important management issue facing this reach is probably the impact of the bleached kraft pulp mill at Hinton. There are limits on the consumption of Bull Trout, Burbot and Mountain Whitefish in this segment due to dioxin and furan contamination (Alberta Environmental Protection, 1995). Another concern is the impact of forestry practices, since 80% of this section of the Athabasca flows through Forestry Management Agreement Areas. The gas industry is also important in the area, as there are two major gas plants nearby and 70% of this segment passes through gas fields. This segment has few opportunities for protection since there are no Provincial or National Parks and no known significant historical sites located adjacent to it. On the positive side, nearly 100% of the surrounding land is provincial Crown land contained in only two municipalities and the IRPs related to this reach appear to facilitate the manageability of the river.

S3. Whitecourt to Athabasca

The dominant issue affecting this segment of the Athabasca is also related to the impacts created by pulp mills. This reach is influenced by four pulp mills upstream (one in Hinton, two in Whitecourt and one on the Lesser Slave River tributary) and there are limitations on the consumption of Burbot and Mountain Whitefish. Since 40% of this reach passes through gas fields and there are two major gas plants nearby, the impacts of the gas industry are also a concern. This section does not have any current protected areas, however, most of the surrounding land is Crown. Management may be further complicated, however, as this reach comes in contact with five different municipalities.

S4. Athabasca to Fort McMurray

The most recent management issue affecting this segment of the Athabasca River is the ALPAC pulp mill north of the Town of Athabasca. This section is also negatively impacted by the four pulp mills located upstream. Nearly 90% of the reach passes through Forest Management Agreement Areas, therefore, the impacts of the forest industry are another major concern. The oil and gas industries also represent management considerations, since a significant proportion of this segment traverses oil and gas fields. There are no protected areas on this section, however, it has been proposed as a Natural River by the AWA (1990). Most of the surrounding land is provincial Crown land.

S5. Fort McMurray to Lake Athabasca

The greatest concern on this stretch of the Athabasca River is the industrial water-use by the oil sands industry and the serious risk of oil contamination. The five pulp mills located upstream also have a negative influence on the last segment of the river. Another important industry in this area is forestry, as nearly two-thirds of this reach traverses Forest Management Agreement Areas (ALPAC). Parts of this section are protected by Wood Buffalo National Park and the recognized importance of the Peace-Athabasca Delta may lead to protective status for this area. The six significant historic sites found on this reach represent another positive factor. Most of the surrounding land is Crown, however, this section has a large number of jurisdictions (city, municipality, National Park and several Indian Reserves) which may complicate its manageability.

Battle

The greatest management obstacles for the Battle River are probably related to low water quantity and quality. The dominant industrial land-use is agriculture, with most of the surrounding upland under cultivation. The mining industry is also important with at least three mines (1 bentonite, 2 coal mines) located near the river. Another management concern is the gas industry (60% of the river flows through gas fields). Urban development is low to moderate on the Battle River. Recreation development is fairly good with a Provincial Park, several campgrounds, wayside recreation areas and ski areas. Management of the Battle River may be difficult because of the ownership patterns (90% private) of adjacent land and the large number of jurisdictions it flows through.

S1. Battle Lake to Dried Meat Lake

Water volumes are generally low and surrounding agricultural run-off tends to decrease water quality. A fairly high proportion (40%) of this reach traverses gas fields and although population concentration is moderate, there is a high concentration of bridges and a fairly high concentration of campgrounds. There are no legally protected areas and most of the neighbouring land is privately owned. This section passes through several jurisdictions, including three counties and three Indian Reserves.

S2. Dried Meat Lake to Forestburg Dam

This relatively short (70 km) segment of the Battle River is also plagued by low water quantity and quality. Agriculture and coal-mining (2 coal mines nearby) are the dominant land-uses, while the gas industry is also important. Urban development is low, with no major population centres located on this reach. Most of the surrounding land is in private hands, except a small proportion that is protected within Big Knife Provincial Park. This segment flows through four different counties.

S3. Forestburg Dam to Saskatchewan Border

The final segment of the Battle River is regulated by the Forestburg Dam and also has problems with water quantity and quality. Most of the neighbouring land is used for agriculture. The oil and gas industries are also prevalent in the area and consequently there is a fairly high concentration of pipelines. Population concentration and urban development are low, while recreational development is moderate with several wayside recreation areas, ski areas and campgrounds. This section of the Battle River flows through five municipalities and CFB Wainwright, with most of the adjacent land privately owned.

Beaver

The Beaver River is a relatively low volume river and sometimes has restricted flow. Most of the surrounding land is utilized for agriculture. Oil and gas are also important industries and there is some heavy use of water for heavy oil injection processing. Urbanization and linear development are generally low, although there is a high concentration of transmission line crossings on the Beaver River. Recreation and tourism developments are very low and there are no legally protected areas next to this river. Management is further complicated by high private ownership of land and at least five different governing jurisdictions. A

relevant IRP (Cold Lake) appears to be generally positive for the management of the river.

Belly

The Belly River has fairly low volumes of water and is impacted by heavy irrigation uses with 90% of the neighbouring land developed for agricultural uses. The river has several diversions and at least one hydro-electric station. Urbanization and linear development are relatively low, however, there is a fairly high concentration of transmission line crossings on the Belly River. A small portion of the river is protected in Waterton Lakes National Park and there are some proposed protected areas outside of the park (AWA, 1990). There is also a high concentration (at least 14) of significant historic sites that may require some form of protection. The Belly River flows through at least five jurisdictions and 90% of the surrounding land is private. This is an international river with its headwaters in the United States, where it is protected within Glacier National Park.

Bow

The Bow River is a heavily-used river. The most significant management concerns are related to hydrological developments. This river has more dams and hydro-electric stations than any other river in Alberta. Irrigation withdrawals are also very heavy which leads to periodic reduced flows. Water quality is generally good above Calgary, but is reduced downstream due to municipal and industrial uses by the city. Agriculture is the dominant land-use with heavy emphasis on irrigation farming and ranching. The gas industry is also prevalent with at least three gas plants located near the river. Population and development along the Bow River are fairly high with the majority concentrated in the Calgary area. Parts of the river are protected in Banff National Park and three Provincial Parks. This river also has a large number of significant historic sites distributed throughout most of its course. Land tenure next to the river is about two-thirds private and it flows through at least 14 different jurisdictions.

S1. Canmore to Morley

Water quality on this segment is generally good, however, Canmore's sewage is a source of pollution. The Horseshoe Dam has an impact on this section of river and is an important management consideration in addition to the Ghost Dam downstream. Most of the land surrounding this reach of the Bow River is agricultural, with grazing as an important activity. The Bow Valley is a heavily-used transportation corridor with a high concentration of bridges and several population centres. Recreational development is fairly good, including Bow Valley Provincial

Park and a very high concentration of campgrounds. This reach also has a very large number (at least 18) of significant historic sites. Most of the adjacent land is private with about half belonging to the Stoney Indian Reserve.

S2. Ghost Dam to Bearspaw Reservoir

This section of the Bow is impacted by the Ghost Dam upstream and by the Bearspaw Dam downstream. Most of the surrounding land is agricultural with ranching an important activity. The surrounding area is heavily utilized by the gas industry since this section passes through two major gas fields. There are at least three gas plants located in the area and a high concentration of pipelines. This section of the Bow Valley is also an important transportation corridor and roads or railways parallel the river throughout it. Although this reach does not have any protected areas, it does have a richness of significant historic sites, some of which may require future protection. Nearly all of this segment is surrounded by private land with some located in an Indian Reserve.

S3. Calgary to Bassano Dam

Water quality is generally poor downstream of Calgary due to municipal and industrial inputs. Irrigation use is very heavy on this segment and may impact water flow which is restricted by at least two weirs. This section has a very high population and bridge concentration, with most development located in the Calgary area. Recreational development is moderate, with parks in Calgary and two Provincial Parks located adjacent to the river. Part of this segment has also been proposed as a Recreation River by the (AWA, 1990). There is also a high concentration (at least 21) of significant historic sites along this reach. This segment passes through at least 6 different jurisdictions (one city, four municipalities, one Indian Reserve) and most of the surrounding land is privately owned.

S4. Bassano Dam to South Saskatchewan River

Heavy irrigation withdrawals from the Bow River upstream of this segment may significantly reduce flows, while the Bassano Dam controls water movement here. Water quality is a particular concern on this segment with mercury contamination problems (Alberta Environmental Protection, 1995), high coliform levels and eutrophication. Surrounding land-use is dominated by irrigation, farming and the gas industry. Most of this reach is adjacent to a major gas field and there are at least two major gas plants nearby. There is also some oil activity near this segment. The last segment of the Bow River is very lightly developed with few parallel roads

and population centres. Recreational development and the number of historical sites are also low. Most of the surrounding land is in private hands, with some leased Crown land. This segment passes through several jurisdictions, including four municipalities and one Indian Reserve.

Brazeau

An important management issue affecting part of the Brazeau River is the impact of the Brazeau Dam and hydro-electric station. The predominant land-uses are forestry and gas-related activities. Water quality is generally excellent and development is very low with no population centres located on the river. The upper reaches of the river are protected by Jasper National Park and Whitegoat Wilderness Area, and also partly bordered by the Bighorn Wildland Recreation Area. No significant historic sites have been located along the Brazeau River to date. The surrounding land is almost entirely owned by the Crown and is administered by at least three jurisdictions (National Park and two municipalities).

S1. Above Brazeau Dam

The segment of the Brazeau upstream of the dam has excellent water quality and is impacted minimally by the dam. The most important land-uses near this reach are forestry and gas-related activities. A Weldwood Forest Management Agreement Area and a major gas field are located adjacent to this section. Linear development and population concentration are almost non existent. The upper reach of this segment is protected by Jasper National Park and Whitegoat Wilderness Area, while another portion is adjacent to the Bighorn Wildland Recreational Area. Surrounding land is nearly 100% Crown land contained within the National Park and two municipalities.

S2. Below Brazeau Dam

This short segment of the Brazeau River is heavily regulated by the Brazeau Dam and may have no water for a period of the year. The predominant land-use activity is forestry, with the entire section contained within a Weyerhaeuser Forest Management Agreement Area. Population concentration and linear development are very light around this reach, while there are no protected areas or known significant historic sites. Nearly 100% of the surrounding land is provincial Crown land and all is located within one municipality. The relevant Brazeau-Pembina (A8) IRP may have a negative influence on river management.

Castle

The Castle River has excellent water quality, but it is a low volume river that is impacted by the Oldman Dam downstream. The dominant land uses are agriculture, natural gas extraction and forestry. A significant proportion of the river flows through agricultural land, with extensive grazing in the upper reaches. A significant portion comes in contact with gas fields and there are several gas wells and seismic lines present in the area. Development near the river is generally low, except for fairly high concentrations of bridges and pipeline crossings. The Castle River has a high concentration of campgrounds. A Wildland Recreation Area and a Provincial Park have both been proposed for the upper reach (Gibbard and Sheppard, 1992). This river also has a large number of significant historical sites. About half of the river is surrounded by Provincial Crown land and it flows through only two municipalities. The Castle River IRP appears to be positive for the long term management of the river.

Clearwater (Athabasca)

One of the greatest management challenges facing the Clearwater (Athabasca) River may be related to the impact of the forestry industry. Nearly the entire river in Alberta is contained within an ALPAC Forest Management Agreement Area. Another concern is the oil industry, since about one-third of the river passes through oil sands deposits, which may be developed in the future. Development and population concentration on this river are very low, with the exception of the Fort McMurray area at its confluence with the Athabasca River. Whitemud Falls Ecological Reserve is the only protected area, however, the river has been proposed as a Natural River by AWA (1990). The Clearwater River flows through at least three different jurisdictions (one municipality, one Indian Reserve, one city) in Alberta and most of the surrounding land falls under the provincial Crown. Most of this river is located in Saskatchewan, where it is protected within a Provincial Park (Heritage River status).

Clearwater (North Saskatchewan)

This river generally has excellent water quality (agricultural run-off may be a problem in lower reaches) and is relatively remote with few developments.. Forestry appears to be the dominant land-use with 30% of the river flowing through Forest Management Agreement Areas (Sunpine). Other land-uses include the agriculture, gas and oil industries. Recreational development is moderate, with the river flowing through Banff National Park and Bighorn Wildland Recreation Area. The Clearwater (North Saskatchewan) has many campgrounds. This river is mostly bordered by Crown land and flows through

only two jurisdictions (National Park and one municipality). The relevant IRP appears to be generally beneficial for the long-term management of this river.

Crowsnest

The Crowsnest is a low volume river that is impacted by the Oldman Dam downstream, however, it has relatively good water quality. The dominant land-use of the area is agriculture, while the gas industry is also important. Although there are presently no active coal mines in the area, a high proportion of the river passes through areas with significant coal deposits which could be developed in the future.

This river has a high concentrations of population centres, bridges and pipeline intersects. Although there are no Provincial or National Parks located along the river, there is a high concentration of campgrounds. The Crowsnest River also has a very high concentration of significant historic resource sites located near it. About 80% of the surrounding land is private and is contained within only two municipalities.

Elbow

The dominant land-use for this river is agriculture with about one-third flowing through agricultural land. The gas industry has a minor economic role in the area surrounding the river. The Glenmore Dam and associated thermal power plant in Calgary have a significant impact on the Elbow River. Development and population concentration are extremely high on the Elbow River, mainly due to the presence of Calgary. Recreational development on the river is fairly high as the river flows through Kananaskis Country and is adjacent to Bragg Creek Provincial Park as well as several urban parks in Calgary. The Elbow River also has a high concentration of campgrounds. About half of the river is surrounded by private land and it traverses at least five different jurisdictions. The Kananaskis Country IRP appears to be somewhat constraining for the management of the Elbow River.

S1. Above Glenmore Reservoir

This segment accounts for most of the Elbow River and a large proportion of it passes through lands used for agricultural purposes. A relatively minor portion of this section comes in contact with gas fields. The Glenmore Dam downstream has an impact. Population concentration is fairly low outside of Calgary with the town of Bragg Creek the only other population centre located on the river, however, a large proportion of the river is paralleled by roads and there is a high concentration of pipeline crossings. Recreation and tourism development is fairly high (Provincial

Park, Kananaskis Country) with a very high concentration of campgrounds. This reach of the river comes in contact with three municipalities, an Indian Reserve and the City of Calgary. About half of the neighbouring land is provincial Crown land.

S2. Below Glenmore Reservoir

This very short (12 km) section of the Elbow River is impacted by the Glenmore Dam, which heavily regulates its flow. This segment is located entirely within the city of Calgary and therefore it is highly developed with an extremely large concentration of population. The land adjacent to this reach of the river is fairly well developed for recreation, with several parks and golf courses.

Highwood

Agriculture is the predominant economic use of the land surrounding the river, with ranching an important activity. The Highwood River also traverses some gas fields. The most significant hydrological development is the Little Bow Diversion in High River, which diverts large amounts of water away from the Highwood River. Development and population concentration are moderate, with the Town of High River the most important centre. This river has no significant protected areas, however there are at least six important historical sites located along it, some of which may require protective measures. Management may be complicated due to the high (75%) private ownership of surrounding land and the somewhat constraining Kananaskis Country (A12) IRP. The Highwood River flows through at least four different jurisdictions.

Little Smoky

The Little Smoky River has dioxin and furan contamination of fish (Alberta Environmental Protection, 1995). Forestry dominates its upper reaches and agriculture its lower reaches. The oil and gas industries are also important and there are three gas plants located near the river. There is one thermal generating station and only one population centre (Little Smoky) located on the river. This river also has very few campgrounds and no known protected areas or significant historic sites. Most of the adjacent land is provincial Crown land contained within two different municipalities. Relevant IRPs appear to be positive for the long term management of the Little Smoky River.

Milk

A management concern of this river is its generally low water quantity, which may become a serious problem during periods of drought. Ranching is the dominant land-use of the surrounding area and, therefore, the impacts of livestock grazing present another important management issue. The gas and oil industries are also fairly prominent in the surrounding area. Another obstacle is hydrological development, since there is a dam located downstream in Montana and another has been proposed in Alberta. Development and urbanization are generally very low along this river and therefore it is still relatively remote. Recreational development is also fairly low, with most of it concentrated in Writing-On-Stone Provincial Park. AWA (1990) has proposed the eastern reach of the Milk River as a Natural River. This river also has a very large number (>100) of significant historical sites, most of which are concentrated in Writing-On-Stone Provincial Park. More than half of the adjacent land is Crown, however, a large proportion of this land is leased for grazing. One of the most complex management constraints relevant to the Milk River is that it is an international river that flows from and back into the United States.

North Saskatchewan

Water quality is a serious management issue facing at least part of the North Saskatchewan River. Heavy industrial and municipal discharges from the Edmonton/Fort Saskatchewan area have a negative impact, while there are also problems with mercury contamination of fish (Alberta Environmental Protection, 1995). Since it is a relatively long river, the North Saskatchewan has a high diversity of land-use issues affecting it. Agriculture is an important industry, since about half of the river flows through agricultural lands. The oil and gas industries are also prominent in lands adjacent to the river, while mining is evident as well, with at least three (coal mine and two salt mines) located in the vicinity of the river. The western portion of the river is also impacted by forestry practices. This river also has several hydrological developments, including two dams (one is located on a tributary) and several electrical generating stations. Overall, development and population base on the North Saskatchewan River are moderate, with most concentrated in the Edmonton area. Recreation and tourist developments along the river are fairly light and limited to the Rocky Mountains area (Banff, Bighorn Wildland Recreation, David Thompson Corridor) and Edmonton. This river also has a fairly large number (at least 30) of significant historical sites distributed throughout its course. The North Saskatchewan flows through a large number of jurisdictions (at least 17) in Alberta and only about 30% of the surrounding land is Crown. The IRPs relevant to this river generally appear to be beneficial for its long term management.

S1. Banff Park Boundary to Abraham Lake

The very short (26 Km) segment between the Banff National Park boundary and Abraham Lake has relatively few serious management conflicts. Perhaps the most significant feature influencing this reach is the Bighorn Dam located downstream. Development along this section of the North Saskatchewan River is very low with the exception of the highway which parallels the river. Recreational development is fairly high with a very large concentration of campgrounds and the Bighorn Wildland Recreational Area is located nearby. Part of this segment is protected by Kootenay Plains Ecological Reserve, while Banff National Park protects the headwaters. There is also a high concentration of significant historical sites, with at least four identified along the river. Management of this short stretch of river is facilitated by the fact that it is contained within a single municipality and nearly 100% of the adjacent land is Crown.

S2. Bighorn Dam to Fort Saskatchewan

This reach is heavily impacted by the Bighorn and Brazeau Dams. Water quality is fairly good, however, there is mercury contamination of some warm water fish species (Alberta Environmental Protection, 1995). Municipal and industrial sewage from Edmonton has a negative impact. Segment 2 is influenced by a broad industrial land base, with the forestry, agriculture, oil and gas industries prominent. There is also at least one active coal mine located near this segment. Urbanization and development is moderate and mainly limited to Rocky Mountain House, Drayton Valley, Devon and Edmonton. Population concentration is high, mainly due to the influence of Edmonton. Recreation facility development is fairly low, however, the section between Nordegg and Edmonton has been proposed as a Recreation River by AWA (1990). Segment 2 of the North Saskatchewan River has at least 18 significant historical resource sites, with most concentrated in Edmonton. About half of the land next to this segment is privately owned, while the entire segment comes in contact with four different municipalities, one Indian Reserve and one city.

S3. Fort Saskatchewan to Saskatchewan Border

The final reach of the North Saskatchewan River suffers from poor water quality due to heavy industrial and municipal discharges and may not meet water quality integrity guidelines. Nearly the entire section flows through agricultural lands and most of the surrounding land is under cultivation. Large portions of this segment dissect oil and gas fields and there are also two salt mines located near it. Urbanization and

development are light along this section and mostly limited to the Fort Saskatchewan area. Recreational development is low, however, there are several (at least 8) significant historical sites along Segment 3. Management of this section is complicated by a large number of jurisdictions (at least 10) and nearly 100% private ownership of surrounding land.

Oldman

The most important management issue facing this river is the controversial Oldman Dam. The Oldman River is also heavily impacted by irrigation use. Water quality is influenced by the City of Lethbridge and some species of fish (walleye, sauger and goldeye) may have mercury contamination (Alberta Environmental Protection, 1995). Most of the surrounding land is used for agricultural purposes with extensive grazing and irrigation farming. The oil and gas industries are of minor importance. While there are no active coal mines in the vicinity of the Oldman River, there is potential for coal development, since about 20% of the river traverses areas with coal fields. Urban development around the river is moderate, with most concentrated in the Lethbridge area. Recreational development is fairly low to moderate, with a large section proposed as a Recreation River by AWA (1990). This river has a high number of significant historical sites. There are few protected areas (Taber Provincial Park, Beehive Natural Area), however, the section from Secondary Road 785 to MacLeod Island has been proposed as a Natural River (AWA, 1990). Management of the Oldman River may be difficult, since only 25% of the surrounding land is Crown, and it flows through several jurisdictions (six municipalities, one city, two Indian Reserves).

S1. Above Oldman Dam

The upper reach of the Oldman River generally has good water quality, however, some species of fish may have mercury contamination (Alberta Environmental Protection, 1995). This section is also impacted by the Oldman Dam downstream. Agriculture is the dominant land-use, with ranching a very important activity on lands adjacent to the river. Linear development and population concentration is light above the Oldman Dam. Segment 1 has several Recreation Areas (Upper Oldman Wildland Recreation Area, Whaleback Wildland Recreation Area and a Recreation River segment) proposed by AWA (1990) and a heavy concentration of campgrounds. Beehive Natural Area is located at the headwaters of the Oldman River. This segment also has at least five significant historical sites located along its course. Land ownership adjacent to the river is

about one-half private and one-half provincial Crown and is administered by only two jurisdictions.

S2. Below Oldman Dam

The second section of the Oldman River is heavily impacted by the Oldman Dam and large irrigation withdrawals, which may have detrimental effects on riparian cottonwood forests (Rood, 1990). There is some industrial water-use and problems with mercury contamination of fish (Alberta Environmental Protection, 1995). Agriculture is the most important land-use, with a heavy emphasis on irrigation farming. The oil and gas industries also have a presence in the area. Population concentration is moderate with the Lethbridge area accounting for most development. Taber Provincial Park is located on this segment, while the section from Secondary Road 785 to MacLeod Island has been proposed as a Natural River by AWA (1990). Segment 2 of the Oldman River has a very high density (>40) of significant historical sites. Management is complicated by a large number of jurisdictions and nearly 100% private ownership of surrounding land.

Peace

The Peace River has very high volumes of water, however, it is regulated by the WAC Bennett in British Columbia and there has been another proposed dam in Alberta at Dunvegan in the past. There are also three thermal power generating stations located on the river. This river is currently impacted by two pulp mills: one at the Town of Peace River and another on a tributary at Grande Prairie. About half of the river flows through agricultural lands or lands with potential for agricultural development. Other industries that affect the Peace River are the forestry, oil and gas industries. Development is very light, with the Town of Peace River the most significant population centre. The most easterly reach of the river is protected by Wood Buffalo National Park, while the most westerly segment has a large concentration of recreational developments. At least 20 significant historical sites have been identified along the Peace River. Management is facilitated by a very high proportion (90%) of Crown land. On the negative side, a large portion of the river is located in British Columbia and in Alberta it flows through many jurisdictions with some detrimental IRPs.

S1. Above Peace River (town)

This segment of the Peace River is heavily impacted by the WAC Bennett Dam and other upstream developments in British Columbia. Water quality is generally good before the Smoky River confluence. Agriculture and forestry are the two dominant land-uses, while the oil and gas

industries are also important. Urbanization/development is light along this stretch, however, recreational development is fairly high. There is a large concentration of recreation areas and the section between Cherry Point and Dunvegan has been proposed as a Recreation River by AWA (1990). There are also several significant historical sites located along Segment 1, as well as the Silver Valley Ecological Reserve. The surrounding land is mostly Crown, however, this segment is administered by at least six municipalities and further complicated by downstream developments in British Columbia.

S2. Peace River (town) to Wood Buffalo Park Border

This section has very high volumes of water, however, it is regulated by the WAC Bennett Dam. Water quality is negatively impacted by pulp mills at Peace River and Grande Prairie. Forestry and agriculture are the most important industries affecting this segment. Segment 2 also contacts some major gas fields and oil sands deposits. Linear development and population concentration along this reach are light, as are recreation developments. Notikewan Provincial Park is located between Peace River and Carcajou. Eleven significant historical sites have been identified along Segment 2 of the Peace River. This section passes through several jurisdictions (three municipalities, four Indian Reserves, one Metis Settlement) before it enters Wood Buffalo National Park and most of the neighbouring land is Crown.

Red Deer

This relatively long river is impacted by the Dickson Dam and some species of fish have mercury contamination (Alberta Environmental Protection, 1995). Forestry has the potential to affect the upper reach while a very large proportion of the river flows through agricultural lands. The oil and gas industries are also very prominent in areas adjacent to the river, while there is at least one active coal mine located near the Red Deer River. Population concentration and urban development is moderate, with Red Deer and Drumheller the two most important centres. The Red Deer River originates in Banff National Park and comes in contact with three Provincial Parks before entering Saskatchewan. The AWA (1990) has proposed one section as a Recreation River and another section as a Natural River. At least 12 significant historical sites have been recorded along the Red Deer River below the Dickson Dam. Management of this river may be constrained by high private ownership (75%) of surrounding land and a large number of jurisdictions (National Park, 14 municipalities, two cities).

S1. Banff Park Boundary to Glenifer Lake

The upper reach of the Red Deer River has good water quality, but has fairly low quantities of water. This section may be impacted by recreation over-use and the Dickson Dam located downstream. The forestry, agriculture, gas and oil industries are all well-represented along this stretch of the Red Deer. Urban development is low, however, a large segment is paralleled by a forestry trunk road. The headwaters of the Red Deer River are protected by Banff National Park and before it enters through the Bighorn Wildland Recreation Area. AWA (1990) has proposed part of Segment 1 as a Recreation River. No significant historical sites have been located on the first segment of the river. This section is contained within five municipalities with more than half of it bordered by provincial Crown land.

S2. Below Dickson Dam

Segment 2 of the Red Deer River is impacted by the Dickson Dam upstream. This section also has mercury contamination of some fish species (Alberta Environmental Protection, 1995). The dominant land-uses influencing this reach are the agriculture (with some irrigation use) and gas industries (at least four gas plants nearby). This segment also traverses a major oil field and passes near at least one active coal mine. Urban and linear development are moderate and mostly concentrated in the Red Deer and Drumheller regions. There are three Provincial Parks located along Segment 2 (Dry Island Buffalo Jump, Midland and Dinosaur) and several proposed protected areas by the AWA (1990), including a Natural River from Highway 36 to the Saskatchewan border. The second reach of the Red Deer also has at least 12 significant historic sites located along its course. Management of this segment is constrained by a large number of jurisdictions and very high private ownership of surrounding land.

Sheep

The Sheep River is a low volume river with relatively good water quality. About half of the river flows through agricultural lands, while the gas and oil industries are also fairly important in adjacent areas. Linear development along this river is moderate, however, it does have a fairly high concentration of transmission line crossings. Part of this river is located within Kananaskis County, where the IRP appears to be constraining to the long term management process. There are at least five known significant historical sites located along the Sheep River. The river flows through two municipalities with approximately 40% of the adjacent land owned by the Crown.

Slave

The Slave River has the largest volume of any river in Alberta, however, it is impacted by the WAC Bennett Dam and may also be affected by a proposed dam in the NWT. Water quality is also affected by several pulp mills on the Peace and Athabasca River Systems and natural pollutants. Industrial land-use is very light in the vicinity, with the possibility of some forestry operation near the river. This remote river has very low population concentration and development, however, about half of the river is paralleled by a road. Almost the entire west bank of the river forms the eastern boundary of Wood Buffalo National Park. The Slave River has been proposed as a Natural River by AWA (1990). Only three significant historic sites have been identified along this river. Management of the Slave River should be facilitated by the fact that the adjacent land is nearly 100% Crown owned, and governed by only two jurisdictions (National Park and municipality).

Smoky

This river is impacted by a pulp mill at Grande Prairie and has dioxin and furan contamination of some fish species (Alberta Environmental Protection, 1995). The Smoky River does not have any dams, however, it does have two thermal power generating plants. The greatest land-use impacts are related to the forestry and agricultural industries, while the oil and gas industries have a minor influence. An active coal mine located near the river represents another concern. Population and urban development are very light along the Smoky River, with Grande Cache and Watino the only two population centres. The upper reaches of the river are protected within Jasper National Park and Willmore Wilderness Park, however, recreation development is rather low overall. This river passes through 7 jurisdictions with about 90% crown land adjacent to it.

South Saskatchewan

This river has moderate volumes of water, however, it is impacted by heavy irrigation withdrawals, most of which are upstream in the Bow and Oldman Rivers. Water quality is also influenced by industrial and municipal uses in the Medicine Hat area. Several species of fish have mercury contamination in the South Saskatchewan River (Alberta Environmental Protection, 1995). This river is impacted by several dams on its tributaries (Bow and Oldman Rivers). The agriculture and gas industries dominate the economy of the area, while linear development is low, with almost all population concentrated in Medicine Hat. Recreational development is also low, however, there are at least 13 significant historic sites located along the South Saskatchewan River in Alberta. Protected areas include the Middle Sand Hills National Wildlife Area and potential Prairie Coulee Ecological Reserve. This river has a fairly large proportion (two-thirds) of Crown land adjacent to it, however, some areas are leased for grazing. The South Saskatchewan River passes through at least six jurisdictions in Alberta.

4.5 Management Summary

Based on our assessment of the critical management issues affecting each of the short-listed rivers we have been able to classify the rivers into two categories; an "A" List representing those rivers having no major management issues and a "B" List representing those rivers which do have some major management concerns.

The chart on the following page summarizes our evaluation.

MANAGEMENT FEASIBILITY SCORING OF RIVERS AND SEGMENTS

Management Summary - "A" and "B" Rivers

SCORE	RIVER
A	Athabasca (Segment 1)
B	Athabasca (Segment 2)
B	Athabasca (Segment 3)
B	Athabasca (Segment 4)
B	Athabasca (Segment 5)
B	Battle (Segment 1)
B	Battle (Segment 2)
B	Battle (Segment 3)
B	Beaver
A	Belly
A	Bow (Segment 1)
B	Bow (Segment 2)
B	Bow (Segment 3)
B	Bow (Segment 4)
A	Brazeau (Segment 1)
B	Brazeau (Segment 2)
A	Castle
A	Clearwater (Athabasca)
A	Clearwater (North Saskatchewan)
A	Crowsnest
A	Elbow (Segment 1)
B	Elbow (Segment 2)
A	Highwood
A	Little Smoky
A	Milk
A	North Saskatchewan (Segment 1)
B	North Saskatchewan (Segment 2)
B	North Saskatchewan (Segment 3)
A	Oldman (Segment 1)
B	Oldman (Segment 2)
A	Peace (Segment 1)
B	Peace (Segment 2)
A	Red Deer (Segment 1)
B	Red Deer (Segment 2)
A	Sheep
A	Slave
A	Smoky
B	South Saskatchewan

5.0 SUMMARY RIVER EVALUATIONS - CONCLUSIONS

To this point, each of the short-listed rivers from Phase 2 has been further evaluated from both a river integrity perspective and a river management feasibility perspective.

Rivers have been classified into "A" and "B" categories based on this evaluation. This classification distinguishes between those rivers having high overall potential for nomination to the CHRS and those having a lower potential for nomination.

A final classification of all short-listed rivers was undertaken by reviewing the "A" or "B "classifications of the rivers in all four categories

Rivers with an "A "classification in two or more integrity ratings and receiving an "A" rating for management feasibility were classified as Double "A" (AA) rivers and are considered most deserving of nomination to the CHRS.

Single "A" (A) rivers are those demonstrating only one "A" rating in either integrity assessment or management feasibility and were considered less deserving for CHRS nomination.

"B" rivers failed to have any "A" classifications in any category or had severe management feasibility problems, thereby limiting their appeal for CHRS nomination.

In addition to reviewing their individual ratings for integrity and management, each short-listed river was also reviewed in terms of potential "deal breakers" that could change its final classification. Deal breakers are those special features found along a river (e g. an internationally recognized trout fishery) or representing serious concerns that could affect a rivers integrity (e g . dams, pollution). The use of dealbreakers in the final evaluation could reclassify rivers from one category to another. For example, some rivers could have been originally classified as a "AA", but due to serious management concerns (i.e. pollution, dams) were downgraded to single "A" classification.

Other rivers might only have qualified for a "B" class, but because they demonstrated high recreation use or values or because they represented a critical natural region in the province, were upgraded to an "A" classification.

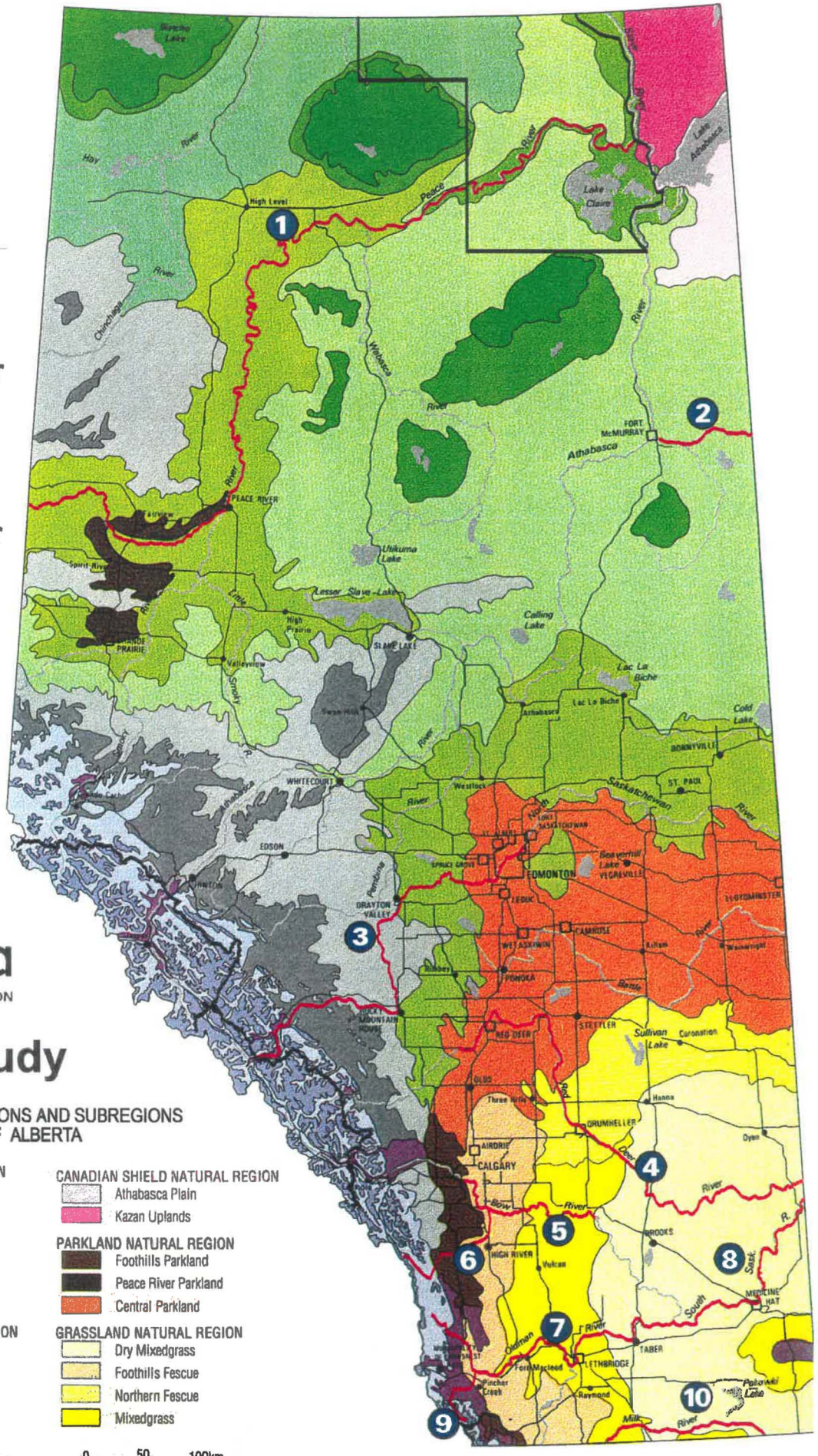
The following table summarizes a recommended classification of short-listed rivers. Map 5 illustrates the distribution of the selected rivers and their relationship to the various Natural Regions in the province.

Map 5

CHRS Priority Rivers (AA)

(not ranked in order of priority)

1. Peace River
2. Clearwater (Athabasca) River
3. N. Saskatchewan River
4. Red Deer River
5. Bow River
6. Highwood River
7. Oldman River
8. S. Saskatchewan River
9. Castle River
10. Milk River



Legend

AA River

National Park Boundary

Alberta
ENVIRONMENTAL PROTECTION

CHRS River Study

NATURAL REGIONS AND SUBREGIONS OF ALBERTA

BOREAL FOREST NATURAL REGION
- Central Mixedwood
- Dry Mixedwood
- Wetland Mixedwood
- Sub-Arctic
- Peace River Lowlands
- Boreal Highlands

ROCKY MOUNTAIN NATURAL REGION
- Alpine
- Sub-Alpine
- Montane

FOOTHILLS NATURAL REGION
- Upper Foothills
- Lower Foothills

CANADIAN SHIELD NATURAL REGION
- Athabasca Plain
- Kazan Uplands

PARKLAND NATURAL REGION
- Foothills Parkland
- Peace River Parkland
- Central Parkland

GRASSLAND NATURAL REGION
- Dry Mixedgrass
- Foothills Fescue
- Northern Fescue
- Mixedgrass

Scale: 0 50 100km

Priority River Classification for CHRS Nomination

AA RIVERS	Bow - Segment 3
	Castle
	Clearwater (Athabasca)
	Highwood
	Milk
	North Saskatchewan - Segments 1 and 2
	Oldman - Segments 1 and 2
	Peace - Segments 1 and 2
	Red Deer - Segment 2
	South Saskatchewan
A RIVERS	Athabasca - Segments 1, 4 and 5
	Battle - Segment 2
	Beaver
	Belly
	Clearwater (N. Sask.)
	Crowsnest
	Little Smoky
	North Saskatchewan - Segment 3
	Red Deer - Segment 1
	Sheep
	Slave
	Smoky
B RIVERS	Athabasca - Segments 2 and 3
	Battle - Segments 1 and 3
	Bow - Segments 1, 2 and 4
	Brazeau - Segments 1 and 2
	Elbow - Segments 1 and 2

The following provides a brief assessment as to how each river was classified.

Bow - Segment 3 - AA

This segment had high integrity ratings for both human heritage and natural heritage factors. In addition, it received high scores for recreation use, including its international sport fishery and canoeing appeal. The Bow in this segment does exhibit serious water management concerns from a sewage treatment and irrigation perspective. Because of this consideration the segment was initially classified as only an "A" river. In the final assessment however, it was felt the other heritage factors were high enough in value to maintain an "AA" ranking.

Castle - AA

The Castle River is a high overall qualifying river in terms of eligibility for nomination to the CHRS. This river had "A" ratings in all three heritage integrity guidelines as well as an "A" rating for its management situation. There are some concerns over how this river might be affected should some recognized form of protection not be given to it. There are also concerns about the impact of the Oldman Dam on its lower reach.

While the Castle river did not rank high in the overall assessment completed in Phase 2, it represents a prime example of how the CHRS system can be applied. Subsequent to the initial evaluations, the Castle River Wilderness Group submitted extensive background data and research findings which help to demonstrate why the ratings for the river could be increased. With this additional information, it became clear that the Castle ended up representing one of the "purest" rivers suitable for CHRS nomination

Clearwater (Athabasca) - AA

The Clearwater rated high for integrity in both natural and recreation use, thus qualifying for an "AA" classification. In addition, the river has few management issues affecting it at this time. Finally, factors including its CHRS designation in Saskatchewan and the fact it is one of Alberta's few westward flowing rivers, supported its "AA" classification.

Highwood - AA

The Highwood ranked high for human heritage integrity and for recreation use, it had the third highest score for recreation in the overall river evaluations. This river also rated high for its recreation management capability due to part of its location within Kananaskis Country.

Milk - AA

The Milk River rated high in both human heritage and natural heritage integrity, thus qualifying for "AA "status. It also rated high for management although there are some concerns such as grazing use and the potential for a dam. The deciding factor to maintain its "AA" classification is that the Milk River is also the only river that represents the Mississippi drainage, thus is unique to Alberta.

North Saskatchewan - Segments 1 & 2 - AA

The North Saskatchewan represents one of the highest ranking rivers in all heritage categories. However, due to the many management issues affecting it, it received a "B" score for management. The "deal maker" in maintaining its "AA" status is the significant historical value of the river and the high recreation use the river receives, particularly from Devon to Fort Saskatchewan.

Oldman - Segments 1 & 2 - AA

The Oldman achieved one of the highest overall assessments in all three heritage categories. Segment 1 (above the dam) had a higher overall rating, while Segment 2 (below the dam) was classified originally as an "A" river due to serious management issues. However, given the extensive recreation use, particularly through the Lethbridge area, the overall river was classified as a "AA".

Peace - Segments 1 & 2 - AA

The Peace represents one of the most significant human heritage rivers in the province. However, it also faces various management issues. Because of its overall strong ratings, its classification as an "AA" river has been maintained.

Red Deer - Segment 2 - AA

The Red Deer represents one of the highest ranking river in all categories, particularly below the Dickson Dam. Although there are numerous management issues affecting this river, its value for natural, human heritage and recreation use is high enough to maintain an "AA" classification.

South Saskatchewan - AA

Rated very high for human and natural heritage values, the South Saskatchewan qualified for "AA" classification. With its management issues, it was considered for a single "A" rating. However, mitigating factors were the increasing recreation use and the urban park influence within Medicine Hat.

5.1 Conclusions

With the final evaluation and classification of the short-listed rivers this phase of the CHRS study is able to conclude with a recommended list of rivers having the most merit for CHRS consideration.

A review of the short-listed rivers, classified as "AA" Rivers, indicates that the selection represents a good cross section of Alberta. All major Natural Zone areas and major drainage basins are represented. All major communities, through which CHRS nominations can be spearheaded, are represented.

The final selection of top priority rivers was also compared to those rivers previously recommended for natural and recreation protection by the AWA (1990). While it is evident that the selection do have some variances, the major rivers short-listed through this study process support recommendations previously made by the AWA (1990).

The study has also demonstrated how the eventual process for CHRS nomination can take place from a grassroots level. While the study has identified a number of "priority" rivers, there is plenty of opportunity for rivers which did not make the priority list to be selected and recommended for further study.

It is hoped that the process through which this study was completed will set the guidelines and parameters by which future CHRS nominations in Alberta can begin, with the end result that in the future, Alberta will have a strong representation of CHRS rivers throughout the province.

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Appendix 1

Scoring Guidelines for River Management Feasibility Assessments

1. Physical Characteristics

a) Water Quantity

Score	Guideline
+5	Mean annual discharge > 10,000,000 acre-feet
+4	Mean annual discharge 3,000,000 - 10,000,000 acre-feet
+3	Mean annual discharge 1,000,000 - 3,000,000 acre-feet
+2	Mean annual discharge 500,000 - 1,000,000 acre-feet
+1	Mean annual discharge < 500,000 acre-feet

b) Water Quality

Score	Guideline
+5 to +4	Water quality appears to meet or exceed all integrity guidelines; remedial measures not required
+3 to +1	Water quality appears to meet most integrity guidelines; remedial measures generally not required
0	Water quality appears to meet some integrity guidelines; remedial measures may be required
-1 to -3	Water quality does not appear to meet integrity guidelines; remedial measures required

2. Industrial Land-Use

a) Forestry

Score	Guideline
-5	81-100% of river flows through lands utilized or available for forest harvesting
-4	61-80% of river flows through lands utilized or available for forest harvesting
-3	41-60% of river flows through lands utilized or available for forest harvesting
-2	21-40% of river flows through lands utilized or available for forest harvesting
-1	1-20% of river flows through lands utilized or available for forest harvesting
0	<1% of river flows through lands utilized or available for forest harvesting

b) Agriculture

Score	Guideline
-5	81-100% of river flows through agricultural lands or lands available for agricultural development
-4	61-80% of river flows through agricultural lands or lands available for agricultural development
-3	41-60% of river flows through agricultural lands or lands available for agricultural development
-2	21-40% of river flows through agricultural lands or lands available for agricultural development
-1	1-20% of river flows through agricultural lands or lands available for agricultural development
0	<1% of river flows through agricultural lands or lands available for agricultural development

c) Oil

Score	Guideline
-5	>70% of river flows through oil extraction areas
-4	51-70% of river flows through oil extraction areas
-3	31-50% of river flows through oil extraction areas
-2	11-30% of river flows through oil extraction areas
-1	1-10% of river flows through oil extraction areas
0	<1% of river flows through oil extraction areas

d) Gas

Score	Guideline
-5	>70% of river flows through gas fields
-4	51-70% of river flows through gas fields
-3	31-50% of river flows through gas fields
-2	11-30% of river flows through gas fields
-1	1-10% of river flows through gas fields
0	<1% of river flows through gas fields

e) Mining

Score	Guideline
-5	3 or more active mines located within 5 km of river
-4	2 active mines located within 5 km of river
-3	1 active mine located within 5 km of river
-2	No active mines located near river; >25% of river flows through areas with coal deposits
-1	No active mines located near river; 1-24% of river flows through areas with coal deposits

0	No active mines located near river; <1% of river flows through areas with coal deposits

3. Industrial Water-Use

Score	Guideline
-5 to -4	Very heavy industrial water-use
-3 to -2	Heavy to moderate industrial water-use
-1	Light industrial water-use
0	Negligible or no industrial water-use

4. Hydrological Development

a) Dams

Score	Guideline
-5	3 or more dams located on main river channel in Alberta
-4	2 dams located on main river channel in Alberta
-3	1 dam located on main river channel in Alberta and at least 1 dam on tributaries
-2	1 dam located on main river channel in Alberta; no dams on tributaries
-1	No dams located on main river channel in Alberta; at least 1 dam on tributaries or on main channel upstream of Alberta or immediately downstream of main channel
0	No dams located on main river channel or any tributaries

b) Generating Stations

Score	Guideline
-5	5 or more electrical generating stations located on river in Alberta
-4	4 electrical generating stations located on river in Alberta
-3	3 electrical generating stations located on river in Alberta
-2	2 electrical generating stations located on river in Alberta
-1	1 electrical generating station located on river in Alberta
0	No electrical generating stations located on river in Alberta

c) Irrigation Use

Score	Guideline
-5 to -4	Very heavy to heavy irrigation use; at least 4 canals or diversions
-3 to -2	Heavy to moderate irrigation use; 1 to 3 canals or diversions
-1	Moderate to light irrigation use; 1 canal or diversion
0	No or insignificant irrigation use; no known canals or diversions

5. Urbanization/development

a) Roads/railways

Score	Guideline
-5	81-100% of river bordered by roads or railways within 2 km of shoreline
-4	61-80% of river bordered by roads or railways within 2 km of shoreline
-3	41-60% of river bordered by roads or railways within 2 km of shoreline
-2	21-40% of river bordered by roads or railways within 2 km of shoreline
-1	1-20% of river bordered by roads or railways within 2 km of shoreline
0	<1% of river bordered by roads or railways within 2 km of shoreline

b) Bridges and Ferries

Score	Guideline
-5	>12.00 river crossings per 100 km of length
-4	9.01-12.00 river crossings per 100 km of length
-3	6.01-9.00 river crossings per 100 km of length
-2	3.01-6.00 river crossings per 100 km of length
-1	0.01-3.00 river crossings per 100 km of length
0	No known river crossings

c) Transmission Lines

Score	Guideline
-5	>3.00 transmission line intersects per 100 km of length
-4	2.01-3.00 transmission line intersects per 100 km of length
-3	1.51-2.00 transmission line intersects per 100 km of length
-2	1.01-1.50 transmission line intersects per 100 km of length
-1	0.01-1.00 transmission line intersects per 100 km of length
0	No known transmission line intersects

d) Pipelines

Score	Guideline
-5	>4.00 pipeline intersects per 100 km of length
-4	3.01-4.00 pipeline intersects per 100 km of length
-3	2.01-3.00 pipeline intersects per 100 km of length
-2	1.01-2.00 pipeline intersects per 100 km of length
-1	0.01-1.00 pipeline intersects per 100 km of length
0	No known pipeline intersects

e) Population Concentration

Score	Guideline
-5	>5000 people per km of length living in population centres located on or within 2 km of river
-4	1001-5000 people per km of length living in population centres located on or within 2 km of river
-3	101-1000 people per km of length living in population centres located on or within 2 km of river
-2	11-100 people per km of length living in population centres located on or within 2 km of river
-1	1-10 people per km of length living in population centres located on or within 2 km of river
0	<1 person per km of length living in population centres located on or within 2 km of river

6. Recreation and Tourism Development

a) Provincial/ National Parks

Score	Guideline
+5	River comes in contact with 5 or more Provincial or National Parks
+4	River comes in contact with 4 Provincial or National Parks
+3	River comes in contact with 3 Provincial or National Parks
+2	River comes in contact with 2 Provincial or National Parks
+1	River comes in contact with 1 Provincial or National Park
0	River does not come in contact with any Provincial or National Parks

b) Recreation Areas

Score	Guideline
+5	>20% of river included in recreation areas (e.g. Bighorn Wildland Recreation Area) or >40% included in proposed recreation areas
+4	15-20% of river included in recreation areas or 30-40% included in proposed recreation areas
+3	10-15% of river included in recreation areas or 20-30% included in proposed recreation areas
+2	5-10% of river included in recreation areas or 10-20% included in proposed recreation areas
+1	<5% of river included in recreation areas or <10% included in proposed recreation areas
0	River not included in any known recreation areas or proposed recreation areas

c) Campgrounds

Score	Guideline
+5	>4.00 campgrounds per 100 km of length
+4	3.01-4.00 campgrounds per 100 km of length
+3	2.01-3.00 campgrounds per 100 km of length
+2	1.01-2.00 campgrounds per 100 km of length
+1	0.01-1.00 campgrounds per 100 km of length
0	No known campgrounds located near river

7. Historic Resource Sites

Score	Guideline
+5	5 or more significant historic sites found adjacent to river
+4	4 significant historic sites found adjacent to river
+3	3 significant historic sites found adjacent to river
+2	2 significant historic sites found adjacent to river
+1	1 significant historic site found adjacent to river
0	No significant historic sites found adjacent to river

8. Protected Areas

Score	Guideline
+5	>80% of river included in protected areas (e.g. National Parks, Provincial Parks, Conservation Natural Areas, Ecological Reserves)
+4	61-80% of river included in protected areas
+3	41-60% of river included in protected areas or >80% included in proposed protected areas
+2	21-40% of river included in protected areas or 41-80% included in proposed protected areas
+1	1-20% of river included in protected areas or 1-40% included in proposed protected areas
0	River not included in any known protected areas or proposed protected areas

9. Management Complications

a) Land Tenure

Score	Guideline
-5	Land adjacent to river is 81-100% privately owned
-4	Land adjacent to river is 61-80% privately owned
-3	Land adjacent to river is 41-60% privately owned
-2	Land adjacent to river is 21-40% privately owned
-1	Land adjacent to river is 1-20% privately owned
0	Land adjacent to river is <1% privately owned

b) Jurisdictions

Score	Guideline
-5	River passes through or is adjacent to 13 or more government jurisdictions (e.g. municipalities, cities, Indian Reserves, National Parks)
-4	River passes through or is adjacent to 10-12 government jurisdictions
-3	River passes through or is adjacent to 7-9 government jurisdictions
-2	River passes through or is adjacent to 4-6 government jurisdictions
-1	River passes through or is adjacent to 2-3 government jurisdictions
0	River contained in 1 government jurisdiction

c) Interprovincial/international

Score	Guideline
-5	River is not protected outside of Alberta; >50% of river is located upstream of provincial border
-4	River is not protected outside of Alberta; <50% of river is located upstream of provincial border
-3	Unprotected river tributary located outside of Alberta
-2	River originates outside of Alberta, but is protected outside of the province
-1	River originates in Alberta and flows into another province, territory or US
0	Entire river and tributaries located in Alberta

d) Integrated Resource Planning (IRP)

Score	Guideline
+2 to +5	IRPs relevant to river generally have a high positive influence on its management
+1	IRPs relevant to river generally have a low positive influence on its management
0	IRPs relevant to river generally have a neutral influence on its management or the influence is not known or IRP system does not apply to river
-1	IRPs relevant to river have a low negative influence on its management or river does not have any relevant IRPs, even though they are applicable
-2 to -5	IRPs relevant to river generally have a high negative influence on its management

Appendix 2

Descriptions of Management Issues Relevant to Rivers and River Segments

Athabasca River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	High volume river (800 cubic metres per second at mouth of Lake Athabasca).
2. Water quality	4 pulp mills on main channel and 1 pulp mill on Lesser Slave River tributary; fish contamination due to mercury, dioxins and furans.
Industrial Land-Use	
1. Forestry	>40% of surrounding land in Forest Management Agreement Areas.
2. Agriculture	>10% of surrounding land is agricultural.
3. Oil	Approximately 30% of river passes through oil sands
4. Gas	Approximately 30% of river passes through gas fields; 4 gas plants in vicinity of river.
5. Mining	River passes through some coal fields.
Industrial Water-Use	4 pulp mills located on river; 1 pulp mill on tributary; oil sands production.
Hydrological Developments	
1. Dams	
2. Generating Stations	1 hydro and 3 thermal stations.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Roads or railways parallel 26% of river.
2. Bridges and Ferries	Low concentration (1.5 bridges per 100 km).
3. Transmission Lines	Low number (1.1 transmission lines per 100 km).
4. Pipelines	Low (<1 pipeline intersect per 100 km).
5. Population Concentration	Fairly low (40 people per km).
6. Population Centres	Hinton, Whitecourt, Fort McMurray are largest centres.
Recreation and Tourism Development	
1. Provincial/National Parks	Jasper and Wood Buffalo National Parks.
2. Recreation Area	Proposed Athabasca Dunes - Richardson Lakeland Wildland Recreation Area (AWA, 1990).
3. Campgrounds	Low concentration (0.7 campgrounds per 100 km).
Historic Resource Sites	At least 18 significant sites.
Protected Areas	About 1/3 is in protected or proposed protected areas. Jasper and Wood Buffalo National Parks; proposed Natural River from Athabasca to Fort McMurray; proposed Fort Assiniboine - Holmes Crossing Conservation Natural Area; proposed Peace - Athabasca Delta Ecological Reserve (AWA, 1990).
Management Complications	
1. Land Tenure	More than 90% Crown land adjacent to river.
2. Jurisdictions	2 National Parks, 8 municipalities, 1 city, 5 Indian Reserves.
3. Interprovincial/International	All in Alberta.
4. Integrated Resource Plans	IRP judged to be beneficial.

Athabasca River (Segment 1 - Jasper Park Boundary to Hinton)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low to moderate volume.
2. Water quality	Generally good water quality; may have fish contamination.
Industrial Land-Use	
1. Forestry	About 50% of river passes through Weldwood Forest Management Agreement Area.
2. Agriculture	
3. Oil	
4. Gas	
5. Mining	Potential coal development area just outside Jasper Park
Industrial Water-Use	
Hydrological Developments	
1. Dams	
2. Generating Stations	1 hydro and 1 thermal station upstream in Jasper Park
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Most of this segment is paralleled by railway or roads.
2. Bridges and Ferries	Moderate concentration (7 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	
5. Population Concentration	Light.
6. Population Centres	Brûlé, Entrance.
Recreation and Tourism Development	
1. Provincial/National Parks	Jasper National Park nearby.
2. Recreation Area	Guest ranch at Brûlé.
3. Campgrounds	Some campgrounds near river.
Historic Resource Sites	4 significant sites.
Protected Areas	National Park located upstream.
Management Complications	
1. Land Tenure	Almost entirely provincial Crown land.
2. Jurisdictions	All in one municipality.
3. Interprovincial/International	
4. Integrated Resource Plans	Coal Branch (A7). IRP is rated as fairly good plan.

Athabasca River (Segment 2 - Hinton to Whitecourt)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volume.
2. Water quality	Pulp mill at Hinton has negative impact; fish contamination.
Industrial Land-Use	
1. Forestry	About 80% passes through Forestry Management Agreement areas (mostly Weldwood; some through Weyerhaeuser).
2. Agriculture	A small portion (< 1%) of this segment near Whitecourt is adjacent to agricultural land.
3. Oil	
4. Gas	About 70% of this segment passes through gas fields; 2 gas plants nearby.
5. Mining	Small potential coal development area near Hinton
Industrial Water-Use	Pulp mill at Hinton.
Hydrological Developments	
1. Dams	
2. Generating Stations	Weldwood thermal station at Hinton.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	About 1/3 of river is paralleled by roads.
2. Bridges and Ferries	Low concentration (2 bridges per 100 km)
3. Transmission Lines	
4. Pipelines	Moderate (2 pipeline intersects per 100 km).
5. Population Concentration	Fairly low (most in Hinton).
6. Population Centres	Hinton.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Fairly low concentration (1.6 campgrounds per 100 km).
Historic Resource Sites	No known significant sites.
Protected Areas	
Management Complications	
1. Land Tenure	Nearly 100% provincial Crown land.
2. Jurisdictions	Two rural municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	Coal Branch (A7); Berland (A3) and Fox Creek (A1); plans for (A3) and (A1) are still in progress. Coal branch believed to be fairly good plan.

Athabasca River (Segment 3 - Whitecourt to Athabasca)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate to high water volume.
2. Water quality	Negatively impacted by pulp mills; fish contamination.
Industrial Land-Use	
1. Forestry	About 10% of river segment is adjacent to Forest Management Agreement Areas (Weyerhaeuser and Slave Lake Pulp Corp.).
2. Agriculture	About 20% of this segment passes through agricultural lands.
3. Oil	
4. Gas	About 40% of this segment traverses gas fields; 2 gas plants nearby.
5. Mining	Small potential coal development area near Whitecourt
Industrial Water-Use	2 pulp mills in Whitecourt; 1 pulp mill at Slave Lake on tributary.
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Minor linear development (<5%).
2. Bridges and Ferries	Low concentration (2.4 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly low (1.7 pipeline intersects per 100 km).
5. Population Concentration	Fairly low.
6. Population Centres	Whitecourt, Fort Assiniboine, Chisholm, Smith.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Low concentration (0.7 campgrounds per 100 km).
Historic Resource Sites	At least 2 significant sites.
Protected Areas	Proposed Fort Assiniboine - Holmes Crossing Conservation Natural Area (AWA, 1990); 2 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	Mostly provincial Crown land (some leased).
2. Jurisdictions	5 rural municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	Athabasca River Sandhills (A101) and Big Bend (C7); Wandering River (C6) plan still in progress. IRPs generally believed to be somewhat constraining for management.

Athabasca River (Segment 4 - Athabasca to Fort McMurray)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Fairly high volume.
2. Water quality	Negatively impacted by 5 pulp mills; fish contamination.
Industrial Land-Use	
1. Forestry	Nearly 90% of this segment traverses Forest Management Agreement Areas (ALPAC).
2. Agriculture	More than 10% of segment passes through agricultural land (Southern part).
3. Oil	80% of this segment dissects oil sands.
4. Gas	About 1/3 of this section comes in contact with gas fields.
5. Mining	
Industrial Water-Use	ALPAC Pulp Mill - North of Athabasca.
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	No roads parallel river except in Athabasca and near Fort McMurray.
2. Bridges and Ferries	Very low concentration (0.7 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Low (1 pipeline intersect per 100 km).
5. Population Concentration	Low (most in Athabasca).
6. Population Centres	Athabasca.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Low concentration (0.7 campgrounds per 100 km).
Historic Resource Sites	House River Cemetery as well as 3 other significant sites.
Protected Areas	Proposed Natural River (AWA, 1990).
Management Complications	
1. Land Tenure	Mostly provincial Crown land (some leased).
2. Jurisdictions	3 rural municipalities, 1 Indian Reserve.
3. Interprovincial/International	
4. Integrated Resource Plans	Wandering River (C6) plan is still in progress.

Athabasca River (Segment 5 - Fort McMurray to Lake Athabasca)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Very high volume.
2. Water quality	Negatively impacted by pulp mills and oil sands use; fish contamination.
Industrial Land-Use	
1. Forestry	60% of this reach passes through ALPAC Forest Management Agreement Areas.
2. Agriculture	
3. Oil	About 60% passes through oil sands.
4. Gas	
5. Mining	
Industrial Water-Use	Oil sands extraction.
Hydrological Developments	
1. Dams	
2. Generating Stations	Suncor thermal station
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Hwy 63 parallels about 20% of river segment north of Fort McMurray.
2. Bridges and Ferries	Very low concentration (0.8 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Very low (0.4 pipeline intersects per 100 km).
5. Population Concentration	Moderate population concentration (most in Fort McMurray).
6. Population Centres	Fort McMurray, Fort McKay, several Indian Reserves.
Recreation and Tourism Development	
1. Provincial/National Parks	Wood Buffalo National Park.
2. Recreation Area	Parks in Fort McMurray; proposed Athabasca Dunes - Richardson Lakeland Wildland Recreation Area (AWA, 1990).
3. Campgrounds	No known campgrounds.
Historic Resource Sites	6 significant sites occur along this segment.
Protected Areas	Wood Buffalo Park; proposed Peace - Athabasca Delta Ecological Reserve (AWA, 1990).
Management Complications	
1. Land Tenure	Nearly 100% Crown land (mostly provincial).
2. Jurisdictions	1 rural municipality, 1 National Park, 5 Indian Reserves 1 city.
3. Interprovincial/International	
4. Integrated Resource Plans	Fort McMurray - Athabasca Oil Sands Plan (C4) is still in progress.

Battle River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low flow (239,000 acre-feet per year at Saskatchewan border).
2. Water quality	May not meet natural integrity guidelines; agricultural related concerns.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Surrounding lands are nearly 100% agricultural.
3. Oil	20% of river passes through oil fields.
4. Gas	60% of river passes through gas fields.
5. Mining	Bentonite mine nearby; 2 coal mines; 20% of river transects coal fields.
Industrial Water-Use	Unknown.
Hydrological Developments	
1. Dams	1 dam near Forestburg and water control structures at Dried Meat Lake and Coal Lake.
2. Generating Stations	1 thermal station.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Low linear development (less than 10%).
2. Bridges and Ferries	Moderate concentration (6.7 bridges per 100 km).
3. Transmission Lines	Fairly high (2.9 transmission line intersects per 100 km).
4. Pipelines	Moderate (2.9 pipeline intersects per 100 km).
5. Population Concentration	Fairly low (16 people/km).
6. Population Centres	Ponoka is largest population centre.
Recreation and Tourism Development	
1. Provincial/National Parks	Big Knife Provincial Park.
2. Recreation Area	Several wayside recreation areas and 4 ski areas (Richard A. Nuxoll Consulting Services Ltd., 1986).
3. Campgrounds	Moderate concentration (2.2 campgrounds per 100 km).
Historic Resource Sites	No significant sites known.
Protected Areas	Minor area adjacent to Big Knife Provincial Park.
Management Complications	
1. Land Tenure	90% privately owned.
2. Jurisdictions	9 municipalities, 3 Indian Reserves, 1 military base.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	No IRPs for Battle River.

Battle River (Segment 1 - Battle Lake to Dried Meat Lake)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume of water.
2. Water quality	Agricultural related concerns.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Most of surrounding land-use is agricultural.
3. Oil	Only about 10% of this segment traverses oil fields.
4. Gas	About 40% of this segment traverses gas fields.
5. Mining	Small area near Dried Meat Lake has potential for coal development.
Industrial Water-Use	
Hydrological Developments	
1. Dams	Water control structure at Dried Meat Lake and Coal Lake.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	About 20% of this segment is paralleled by roads (mostly near Ponoka).
2. Bridges and Ferries	High concentration (12.3 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	High (4.6 pipeline intersects per 100 km).
5. Population Concentration	Moderate to low (45 people/km).
6. Population Centres	Ponoka
Recreation and Tourism Development	
1. Provincial/National Parks	0
2. Recreation Area	Ski area near Gwynne; wayside recreation area.
3. Campgrounds	Fairly high concentration (3.1 campgrounds per 100 km).
Historic Resource Sites	No significant sites known.
Protected Areas	No known protected areas.
Management Complications	
1. Land Tenure	Nearly 100% privately owned.
2. Jurisdictions	3 municipalities (Counties 10, 3 and 22); 3 adjacent Indian Reserves.
3. Interprovincial/International	
4. Integrated Resource Plans	None.

Battle River (Segment 2 - Dried Meat Lake to Forestburg Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume of water (mean 6 m^3/sec. Forestburg); water controlled at Dried Meat Lake.
2. Water quality	Sometimes poor; high nutrient levels; winter fish kills.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Nearly 100% of surrounding land is agricultural.
3. Oil	Minimal contact with oil fields.
4. Gas	About 30-40% of this segment passes through gas fields.
5. Mining	2 coal mines; entire section passes through coal fields
Industrial Water-Use	Not known.
Hydrological Developments	
1. Dams	Forestburg Dam downstream; water control structure at Dried Meat Lake.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Very minimal.
2. Bridges and Ferries	Moderate concentration (5.7 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly low (1.4 pipeline intersects per 100 km).
5. Population Concentration	Very low.
6. Population Centres	
Recreation and Tourism Development	
1. Provincial/National Parks	Big Knife Provincial Park.
2. Recreation Area	
3. Campgrounds	Moderate concentration (2.9 campgrounds per 100 km).
Historic Resource Sites	No significant sites known.
Protected Areas	Big Knife Provincial Park.
Management Complications	
1. Land Tenure	Almost all private land, except Provincial Park.
2. Jurisdictions	4 counties (22, 6, 29, 18).
3. Interprovincial/International	
4. Integrated Resource Plans	None.

Battle River (Segment 3 - Forestburg Dam to Saskatchewan Border)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume (239,000 acre-feet per year at Saskatchewan border).
2. Water quality	Water quality generally poor (P, N, Na, Mn levels exceed limits upstream of Hardisty).
Industrial Land-Use	
1. Forestry	
2. Agriculture	Nearly 100% of surrounding land is agricultural.
3. Oil	River passes through major oil field near Wainwright.
4. Gas	Most of this section passes through gas fields, with some major gas fields.
5. Mining	
Industrial Water-Use	Unknown.
Hydrological Developments	
1. Dams	Forestburg Dam and dam on tributary.
2. Generating Stations	Battle River thermal station
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Only minor portions of this river segment are followed by roads.
2. Bridges and Ferries	Fairly low concentration (4.2 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly low (3.2 pipeline intersects per 100 km).
5. Population Concentration	Low.
6. Population Centres	Alliance, Hardisty, Fabyan.
Recreation and Tourism Development	
1. Provincial/National Parks	0
2. Recreation Area	4 wayside recreation areas, 3 ski areas.
3. Campgrounds	Moderate concentration (2.6 campgrounds per 100 km).
Historic Resource Sites	No known significant sites.
Protected Areas	3 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	Mostly privately owned, some Federal land.
2. Jurisdictions	5 municipalities; CFB Wainwright.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	None.

Beaver River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume river (722,000 acre-feet per year at Saskatchewan border).
2. Water quality	Appears to meet integrity guidelines.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Nearly all surrounding land is agricultural.
3. Oil	70% of river passes through oil fields.
4. Gas	70% of river passes through gas fields.
5. Mining	
Industrial Water-Use	Oil injection.
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	10% of river is adjacent to transportation corridors.
2. Bridges and Ferries	Fairly low concentration (4 bridges per 100 km).
3. Transmission Lines	Very high (3.1 transmission lines per 100 km).
4. Pipelines	Low (0.9 pipeline intersects per 100 km).
5. Population Concentration	Low.
6. Population Centres	Beaver Lake and Medley are near river while Beaver Crossing is located on Beaver River.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Fairly low concentration.
Historic Resource Sites	One significant site.
Protected Areas	1 reserved Natural Area near headwaters (AEP, 1993).
Management Complications	
1. Land Tenure	Nearly 2/3 of land is privately owned.
2. Jurisdictions	3 municipalities, 1 Indian Reserve, 1 military base.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	IRP generally positive for management.

Belly River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Fairly low volume (882,000 acre-feet per year at U.S. border - impacted by irrigation withdrawals).
2. Water quality	Mountain stream - fairly good.
Industrial Land-Use	
1. Forestry	
2. Agriculture	90% of surrounding land is agricultural.
3. Oil	
4. Gas	River passes through some gas fields.
5. Mining	
Industrial Water-Use	
Hydrological Developments	
1. Dams	Impacted by Oldman River Dam.
2. Generating Stations	1 hydro-electric station.
3. Irrigation Use	Very heavy; at least 4 canals; diversion to St. Mary River.
Urbanization/Development	
1. Roads/Railways	16% of river has roads nearby.
2. Bridges and Ferries	Fairly low concentration (nearly 5 bridges per 100 km).
3. Transmission Lines	Fairly high (2.4 transmission line crossings per 100 km).
4. Pipelines	Fairly low (1.6 pipeline intersects per 100 km).
5. Population Concentration	Low population concentration (9 people/km).
6. Population Centres	Hillspring, Glenwood, Stand Off.
Recreation and Tourism Development	
1. Provincial/National Parks	Waterton Lakes National Park
2. Recreation Area	
3. Campgrounds	Fairly low concentration (1.57 campgrounds per 100 km).
Historic Resource Sites	At least 14 significant sites.
Protected Areas	About 1/3 of river is contained in protected areas or proposed protected areas. Waterton Lakes National Park; proposed Natural River between Secondary Roads 505 and 511 (AWA, 1990); proposed Paine - Beaver Dam Conservation Natural Area (AWA, 1990).
Management Complications	
1. Land Tenure	90% of land is private, adjacent to river.
2. Jurisdictions	National Park, 2 municipalities; 2 Indian Reserves.
3. Interprovincial/International	Headwaters in U.S. (Glacier National Park).
4. Integrated Resource Plans	IRP judged to be somewhat constraining.

Bow River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volume of water (2,382,000 acre-feet per year at Calgary).
2. Water quality	City of Calgary has negative impact; some mercury contamination downstream of Calgary.
Industrial Land-Use	
1. Forestry	River does not pass through any Forest Management Agreement Areas.
2. Agriculture	75% agricultural land.
3. Oil	River passes through some oil fields.
4. Gas	40% of river traverses gas fields; 3 gas plants nearby.
5. Mining	15% of river traverses coal fields.
Industrial Water-Use	Industrial use in Calgary.
Hydrological Developments	
1. Dams	At least 4 dams and several on tributaries.
2. Generating Stations	6 hydro-electric stations.
3. Irrigation Use	5 irrigation canals; heavy water use.
Urbanization/Development	
1. Roads/Railways	Bow river valley is a heavily used transportation corridor.
2. Bridges and Ferries	Moderate concentration (large number of bridges in Calgary).
3. Transmission Lines	High (nearly 3 transmission line crossings per 100 km).
4. Pipelines	Low (less than 1 pipeline intersect per 100 km).
5. Population Concentration	High population concentration (more than 1000 people per km).
6. Population Centres	Banff, Canmore, Cochrane, Calgary are largest centres.
Recreation and Tourism Development	
1. Provincial/National Parks	Bow Valley, Fish Creek, Wyndham - Carseland, Banff.
2. Recreation Area	Proposed recreation river from Bearspaw Dam to Blackfoot Indian Reserve; Calgary parks.
3. Campgrounds	Moderate concentration (more than 2 campgrounds per 100 km).
Historic Resource Sites	A large number of significant historic sites are located along the Bow River.
Protected Areas	Banff National Park and Provincial Parks (about 15% of river is protected).
Management Complications	
1. Land Tenure	1/3 Crown land.
2. Jurisdictions	1 National Park, 8 municipalities, 1 city, 4 Indian Reserves.
3. Interprovincial/International	All in Alberta.
4. Integrated Resource Plans	IRP slightly beneficial for management.

Bow River (Segment 1 - Canmore to Morley)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low to moderate volumes at this point.
2. Water quality	Generally good; Canmore sewage is a source of pollution.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Mostly agricultural land surrounding river; ranching important activity.
3. Oil	
4. Gas	
5. Mining	
Industrial Water-Use	Some industrial use in Canmore.
Hydrological Developments	
1. Dams	Horseshoe Dam, Ghost Dam downstream.
2. Generating Stations	2 hydro stations in Banff Park (Cascade and Rundle); 2 hydro stations outside Park (Kananaskis and Horseshoe).
3. Irrigation Use	Low.
Urbanization/Development	
1. Roads/Railways	This entire segment is flanked by roads and railways.
2. Bridges and Ferries	Very high concentration (15 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	
5. Population Concentration	Moderate (206 people/km).
6. Population Centres	Canmore, Deadman's Flats, Exshaw, Kananaskis, Seebe, Morley.
Recreation and Tourism Development	
1. Provincial/National Parks	Banff National Park is located near this segment; Bow Valley Provincial Park.
2. Recreation Area	2 guest ranches.
3. Campgrounds	Very high concentration (10 campgrounds per 100 km).
Historic Resource Sites	A large number of significant sites (at least 18).
Protected Areas	Provincial Park; Bow Valley Natural Area (AEP, 1993).
Management Complications	
1. Land Tenure	About half of this segment passes through the Stoney Indian Reserve; most of the remaining surrounding land is private.
2. Jurisdictions	Municipality of Bighorn, Indian Reserves.
3. Interprovincial/International	
4. Integrated Resource Plans	Bow Corridor (A103).

Bow River (Segment 2 - Ghost Dam to Bearspaw Reservoir)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low to moderate water volume at this point.
2. Water quality	Generally good above Calgary; "Canmore Corridor" produces sewage.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Mostly agricultural land; ranching important activity.
3. Oil	
4. Gas	This segment passes through 2 major gas fields west of Cochrane; 3 gas plants nearby.
5. Mining	
Industrial Water-Use	Some at Cochrane.
Hydrological Developments	
1. Dams	Ghost Dam, Bearspaw Dam downstream.
2. Generating Stations	Ghost hydro station
3. Irrigation Use	Low.
Urbanization/Development	
1. Roads/Railways	Roads or railways are adjacent to entire segment.
2. Bridges and Ferries	Moderate concentration (5.7 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	High (5.7 pipeline intersects per 100 km).
5. Population Concentration	Moderate (150 people per km).
6. Population Centres	Cochrane.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Moderate concentration (2.9 campgrounds per 100 km).
Historic Resource Sites	10 significant sites.
Protected Areas	
Management Complications	
1. Land Tenure	Nearly 100% of this segment flows through private lands.
2. Jurisdictions	All within Municipality No. 44, 1 Indian Reserve.
3. Interprovincial/International	
4. Integrated Resource Plans	None.

Bow River (Segment 3 Calgary to Bassano Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate (2,380,000 acre-feet per year) flow at Calgary; Elbow and Highwood Rivers increase volume; seasonally low flows occasionally occur.
2. Water quality	Generally poor below Calgary; high coliform bacteria levels; elevated nutrient levels; organic contaminants.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Mostly agricultural land; irrigation farming.
3. Oil	
4. Gas	This section passes through several gas fields, including one major one just before the Bassano dam.
5. Mining	A section near Bassano Dam has potential for coal development
Industrial Water-Use	Fairly heavy within Calgary.
Hydrological Developments	
1. Dams	WID weir and Carseland weir; Bearspaw Dam upstream, Bassano Dam downstream.
2. Generating Stations	Bearspaw hydro station
3. Irrigation Use	Very heavy irrigation use.
Urbanization/Development	
1. Roads/Railways	Low linear development outside of Calgary.
2. Bridges and Ferries	Very high concentration - most in Calgary (16 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly low concentration (1.2 per 100 km).
5. Population Concentration	High (4200 people/km).
6. Population Centres	Calgary, Carseland.
Recreation and Tourism Development	
1. Provincial/National Parks	Fish Creek and Wyndham - Carseland Provincial Parks.
2. Recreation Area	Calgary Parks; proposed recreation river (AWA, 1990).
3. Campgrounds	Fairly low concentration (1.8 campgrounds per 100 km).
Historic Resource Sites	At least 21 significant sites (>12 in Calgary).
Protected Areas	Inglewood Bird Sanctuary in Calgary; Provincial Parks; 1 reserved Natural Area (AEP, 1993).
Management Complications	
1. Land Tenure	Almost entirely private land.
2. Jurisdictions	City of Calgary, 4 municipalities, 1 Indian Reserve.
3. Interprovincial/International	
4. Integrated Resource Plans	None.

Bow River (Segment 4 - Bassano Dam to Grand Forks)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volumes; heavy irrigation withdrawals upstream.
2. Water quality	Mercury contamination of fish; high coliform levels; eutrophication.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Surrounding land is almost entirely agricultural with extensive irrigation.
3. Oil	There are a few major oil fields adjacent to about 10% of this section.
4. Gas	Almost the entire section forms the south-west border of the largest major gas field in Alberta; 2 gas plants nearby.
5. Mining	About 30% of this segment traverses potential coal development areas
Industrial Water-Use	Low industrial use.
Hydrological Developments	
1. Dams	Bassano Dam.
2. Generating Stations	
3. Irrigation Use	Moderate irrigation use; heavy use upstream.
Urbanization/Development	
1. Roads/Railways	A very minimal proportion of this section is paralleled by roads.
2. Bridges and Ferries	Low concentration (2.2 crossings per 100 km)
3. Transmission Lines	
4. Pipelines	Fairly low (1.1 pipeline intersects per 100 km)
5. Population Concentration	Very low.
6. Population Centres	Bow City (Bassano and Scandia nearby).
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Fairly low concentration (1.1 campgrounds per 100 km).
Historic Resource Sites	One significant site has been located on this segment.
Protected Areas	1 reserved Natural Area (AEP, 1993).
Management Complications	
1. Land Tenure	Mostly private land; some provincial Crown land; several lease-holders.
2. Jurisdictions	4 municipalities, 1 Indian Reserve.
3. Interprovincial/International	
4. Integrated Resource Plans	Eastern Irrigation District (E3) - plan still in progress.

Brazeau River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate water flow; regulated by dam.
2. Water quality	Exceeds all water quality integrity guidelines.
Industrial Land-Use	
1. Forestry	Weldwood and Weyerhaueser are Forest Management Agreement holders.
2. Agriculture	
3. Oil	Some oil fields are located near river.
4. Gas	20% of river traverses gas fields.
5. Mining	River traverses some coal fields.
Industrial Water-Use	
Hydrological Developments	
1. Dams	Brazeau Dam.
2. Generating Stations	Hydro-electric generating station.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Transportation corridors parallel about 7% of river.
2. Bridges and Ferries	Low concentration (0.9 bridges per 100 km).
3. Transmission Lines	Fairly low (1.34 transmission lines per 100 km).
4. Pipelines	Low (0.9 pipeline intersects per 100 km).
5. Population Concentration	Very light.
6. Population Centres	No population centres.
Recreation and Tourism Development	
1. Provincial/National Parks	Jasper National Park
2. Recreation Area	Bighorn Wildland Recreation area.
3. Campgrounds	Low concentration (0.9 campgrounds per 100 km).
Historic Resource Sites	No known significant sites.
Protected Areas	Jasper National Park, Whitegoat Wilderness Area, Marshybank Ecological Reserve.
Management Complications	
1. Land Tenure	Nearly 100% Crown land.
2. Jurisdictions	1 National Park, 2 municipalities.
3. Interprovincial/International	All in Alberta.
4. Integrated Resource Plans	Generally neutral to constraining for river management.

Brazeau River (Segment 1 - Above Brazeau Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate water flow,
2. Water quality	Excellent water quality.
Industrial Land-Use	
1. Forestry	Weldwood Forest Management Agreement Area is adjacent to small proportion of this segment.
2. Agriculture	
3. Oil	
4. Gas	This section flows through a major gas field just before the reservoir.
5. Mining	Small potential coal development area near Jasper Park
Industrial Water-Use	
Hydrological Developments	
1. Dams	Brazeau Dam downstream.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	A small part of this section is paralleled by Forestry Trunk Road.
2. Bridges and Ferries	Very low concentration (0.6 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly low (1.3 pipeline intersects per 100 km).
5. Population Concentration	Very light.
6. Population Centres	0
Recreation and Tourism Development	
1. Provincial/National Parks	Jasper National Park.
2. Recreation Area	Bighorn Wildland Recreation Area; Reservoir.
3. Campgrounds	Fairly low concentraton (1.3 campgrounds per 100 km).
Historic Resource Sites	None known.
Protected Areas	National Park; Whitegoat Wilderness Area; Marshy Bank Ecological Reserve.
Management Complications	
1. Land Tenure	Nearly 100% Crown land (mostly provincial).
2. Jurisdictions	1 National Park, 2 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	David Thompson Corridor (A102); Coal Branch (A7); Brazeau Pembina (A8).

Brazeau River (Segment 2 - Below Brazeau Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Regulated by dam (subject to extremes in flow).
2. Water quality	Good.
Industrial Land-Use	
1. Forestry	This entire section is located within a Weyerhaeuser Forest Management Agreement Area.
2. Agriculture	
3. Oil	
4. Gas	
5. Mining	
Industrial Water-Use	
Hydrological Developments	
1. Dams	Brazeau Dam.
2. Generating Stations	Big Bend hydro station.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	No linear development.
2. Bridges and Ferries	Low concentration (1 at dam).
3. Transmission Lines	
4. Pipelines	Fairly high (only 1 pipeline, but segment is very short).
5. Population Concentration	Very light.
6. Population Centres	0
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	
Historic Resource Sites	None known.
Protected Areas	
Management Complications	
1. Land Tenure	Nearly 100% provincial Crown land.
2. Jurisdictions	All located within 1 municipality.
3. Interprovincial/International	
4. Integrated Resource Plans	The Brazeau-Pembina (A8) plan is considered to be constraining to management.

Castle River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume.
2. Water quality	Excellent water quality.
Industrial Land-Use	
1. Forestry	Located within C3 Forest Management Unit; areas near river have been logged.
2. Agriculture	About 50% flows through agricultural lands; extensive grazing.
3. Oil	
4. Gas	Large proportion of river passes through gas fields; several gas wells and seismic lines.
5. Mining	The river traverses at least one potential coal development area and there are some coal leases (Gibbard and Sheppard, 1992)..
Industrial Water-Use	
Hydrological Developments	
1. Dams	Impacted by Oldman Dam.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Small proportion of river is paralleled by roads.
2. Bridges and Ferries	Fairly high concentration (9.2 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly high (3.1 pipeline intersects per 100 km)
5. Population Concentration	Low.
6. Population Centres	None.
Recreation and Tourism Development	
1. Provincial/National Parks	Proposed Provincial Park (Gibbard and Sheppard, 1992).
2. Recreation Area	Proposed South Castle Wildland Recreation Area (AWA, 1990).
3. Campgrounds	High concentration (4.6 campgrounds per 100 km)
Historic Resource Sites	At least 9 significant sites.
Protected Areas	Proposed Provincial Park and proposed Big Sagebrush Natural Area (Gibbard and Sheppard, 1992); reserved Natural Area nearby (AEP, 1993).
Management Complications	
1. Land Tenure	About half is provincial Crown land.
2. Jurisdictions	2 municipalities.
3. Interprovincial/International	All in Alberta.
4. Integrated Resource Plans	The Castle River (E5) IRP is considered to be beneficial for long term management.

Clearwater (Athabasca) River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate flow (2,233,000 acre-feet per year at Saskatchewan border).
2. Water quality	Meets or exceeds all water quality integrity guidelines; possible natural pollutants.
Industrial Land-Use	
1. Forestry	Most of river bordered by ALPAC Forest Management Agreement Area (Millar Western is quota holder).
2. Agriculture	Market gardens on edge of Fort McMurray.
3. Oil	Oil sands deposits adjacent to 30% of river.
4. Gas	
5. Mining	
Industrial Water-Use	
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	About 10% of river is developed in Fort McMurray area.
2. Bridges and Ferries	
3. Transmission Lines	
4. Pipelines	
5. Population Concentration	Almost all concentrated in Fort McMurray.
6. Population Centres	Fort McMurray at confluence with Athabasca River is only population centre.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Urban parks in Fort McMurray.
3. Campgrounds	6 Forestry campgrounds.
Historic Resource Sites	Three significant sites located near river.
Protected Areas	Whitemud Falls Ecological Reserve, proposed Natural River (AWA, 1990).
Management Complications	
1. Land Tenure	95% provincial Crown land.
2. Jurisdictions	1 municipality, 1 city, 1 Indian Reserve.
3. Interprovincial/International	Most of the Clearwater is in Saskatchewan, where it has been designated as a Heritage River.
4. Integrated Resource Plan	No IRPs relevant to river.

Clearwater River (North Saskatchewan)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low to moderate volumes.
2. Water quality	Excellent quality, exceeds all integrity guidelines.
Industrial Land-Use	
1. Forestry	30% of river passes through Sunpine Forest Management Agreement Areas.
2. Agriculture	About 25% of river is bordered by agricultural land.
3. Oil	Traverses some oil fields.
4. Gas	About 20% of river passes through gas fields.
5. Mining	A small proportion of the river intersects coal fields.
Industrial Water-Use	
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Roadways follow about 20% of river.
2. Bridges and Ferries	Fairly low concentration (3.6 bridges per 100 km).
3. Transmission Lines	Moderate (1.5 transmission line crossings per 100 km).
4. Pipelines	Low (1 pipeline crossing per 100 km).
5. Population Concentration	Very low.
6. Population Centres	No population centres; Rocky Mountain House is downstream of confluence with North Saskatchewan River.
Recreation and Tourism Development	
1. Provincial/National Parks	Banff National Park
2. Recreation Area	Bighorn Wildland Recreation Area.
3. Campgrounds	Fairly high concentration (3 campgrounds per 100 km).
Historic Resource Sites	3 significant sites associated with river.
Protected Areas	Banff National Park; 2 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	17% private land.
2. Jurisdictions	1 National Park, 1 municipality.
3. Interprovincial/International	
4. Integrated Resource Plans	IRP beneficial for management.

Crowsnest River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume.
2. Water quality	Meets or exceeds all water quality integrity guidelines.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Almost all agricultural land.
3. Oil	
4. Gas	Gas plant at Coleman.
5. Mining	High proportion (36%) of coal fields; no active coal mines.
Industrial Water-Use	Unknown.
Hydrological Developments	
1. Dams	Impacted by Oldman River Dam.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Heavy linear development (90%)
2. Bridges and Ferries	Very high concentration of bridges (25 per 100 km).
3. Transmission Lines	Moderate (1.8 transmission line crossings per 100 km).
4. Pipelines	High (more than 5 pipeline intersects per 100 km).
5. Population Concentration	Moderate (125 people per km).
6. Population Centres	High concentration of population centres on a small river (Coleman, Blairmore, Frank, Hillcrest Mines, Bellevue, Burmis).
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	High concentration (more than 5 campgrounds per 100 km).
Historic Resource Sites	At least 33 significant sites located near river.
Protected Areas	Reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	About 20% of adjacent land is Crown.
2. Jurisdictions	2 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	IRP rated positive for river management.

Elbow River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volumes.
2. Water quality	Meets or exceeds all water quality integrity guidelines.
Industrial Land-Use	
1. Forestry	
2. Agriculture	30% agricultural land.
3. Oil	
4. Gas	Passes through some gas fields.
5. Mining	
Industrial Water-Use	Low.
Hydrological Developments	
1. Dams	Glenmore Reservoir.
2. Generating Stations	Thermal generating plant.
3. Irrigation Use	Some irrigation use.
Urbanization/Development	
1. Roads/Railways	36% of river is paralleled by roads or railways.
2. Bridges and Ferries	High concentration (18 bridges per 100 km).
3. Transmission Lines	High (5 transmission lines per 100 km).
4. Pipelines	High (4 pipeline crossings per 100 km).
5. Population Concentration	Very high.
6. Population Centres	Bragg Creek and Calgary.
Recreation and Tourism Development	
1. Provincial/National Parks	Bragg Creek Provincial Park.
2. Recreation Area	Kananaskis Country; proposed Elbow-Sheep Wildland Recreation Area (AWA, 1990); Calgary Parks.
3. Campgrounds	High concentration (6 campgrounds per 100 km).
Historic Resource Sites	One in Calgary.
Protected Areas	Provincial Park.
Management Complications	
1. Land Tenure	50% of land next to river is Crown land.
2. Jurisdictions	3 municipalities, 1 Indian Reserve, 1 city.
3. Interprovincial/International	
4. Integrated Resource Plans	IRP constraining for management.

Elbow River (Segment 1 - Above Glenmore Reservoir)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volumes.
2. Water quality	Generally good above Calgary.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Nearly half of this segment flows through agricultural lands.
3. Oil	
4. Gas	Comes in contact with some gas fields.
5. Mining	
Industrial Water-Use	Low.
Hydrological Developments	
1. Dams	Glenmore Reservoir Dam is downstream.
2. Generating Stations	
3. Irrigation Use	Low.
Urbanization/Development	
1. Roads/Railways	A large proportion of this segment is paralleled by roads.
2. Bridges and Ferries	Fairly low concentration (3.8 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	High (5.1 pipeline intersects per 100 km).
5. Population Concentration	Fairly low outside of Calgary.
6. Population Centres	Bragg Creek, Calgary.
Recreation and Tourism Development	
1. Provincial/National Parks	Bragg Creek Provincial Park.
2. Recreation Area	Kananaskis Country; proposed Elbow-Sheep Wildland Recreation Area (AWA, 1990); ski area; parks in Calgary.
3. Campgrounds	Very high concentration (7.7 campgrounds per 100 km).
Historic Resource Sites	One known significant site.
Protected Areas	Provincial Park.
Management Complications	
1. Land Tenure	About 50% provincial Crown land adjacent to river.
2. Jurisdictions	3 municipalities, 1 Indian Reserve, City of Calgary.
3. Interprovincial/International	
4. Integrated Resource Plans	IRP constraining.

Elbow River (Segment 2 - Below Glenmore Reservoir)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Restricted flow.
2. Water quality	Occasional high levels of nutrients and phenols.
Industrial Land-Use	
1. Forestry	
2. Agriculture	
3. Oil	
4. Gas	
5. Mining	
Industrial Water-Use	Low
Hydrological Developments	
1. Dams	Glenmore Reservoir Dam.
2. Generating Stations	Glenmore thermal station
3. Irrigation Use	Some irrigation use.
Urbanization/Development	
1. Roads/Railways	100% developed (Calgary).
2. Bridges and Ferries	Extremely high concentration (13).
3. Transmission Lines	
4. Pipelines	
5. Population Concentration	Very high.
6. Population Centres	Calgary.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Several parks and golf courses.
3. Campgrounds	
Historic Resource Sites	No significant sites known.
Protected Areas	
Management Complications	
1. Land Tenure	All within Calgary (mostly private).
2. Jurisdictions	City of Calgary.
3. Interprovincial/International	
4. Integrated Resource Plans	None.

Highwood River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low to moderate volumes.
2. Water quality	Meets all human heritage and recreation integrity guidelines; may not meet natural integrity guidelines.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Nearly 60% of river traverses agricultural land.
3. Oil	
4. Gas	River dissects some gas fields.
5. Mining	
Industrial Water-Use	Low.
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	Little Bow Diversion.
Urbanization/Development	
1. Roads/Railways	40% of river is linear developed.
2. Bridges and Ferries	Fairly low concentration (more than 5 bridges per 100 km).
3. Transmission Lines	Moderate (1.7 transmission line crossings per 100 km).
4. Pipelines	Fairly low (1.7 pipeline traverses per 100 km).
5. Population Concentration	Moderate (38 people/km).
6. Population Centres	Longview, High River and Aldersyde are only population centres.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Kananaskis Country; proposed Elbow-Sheep Wildland Recreation Area (AWA, 1990).
3. Campgrounds	Fairly low concentration (1.7 campgrounds per 100 km).
Historic Resource Sites	6 significant historic sites.
Protected Areas	
Management Complications	
1. Land Tenure	About 75% private land.
2. Jurisdictions	2 municipalities, 1 Indian Reserve.
3. Interprovincial/International	
4. Integrated Resource Plans	IRP considered to be constraining.

Little Smoky River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate flow.
2. Water quality	Seems to meet most integrity guidelines; dioxin and furan contamination of fish.
Industrial Land-Use	
1. Forestry	50% of surrounding land in Forest Management Agreement Areas (Weyerhaeuser, ANC, Canadian Forest Products).
2. Agriculture	50% agricultural land.
3. Oil	20% of river flows through oil fields.
4. Gas	20% passes through gas fields; 3 gas plants nearby.
5. Mining	
Industrial Water-Use	
Hydrological Developments	
1. Dams	
2. Generating Stations	1 thermal plant (Sturgeon).
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Low linear development (<5%).
2. Bridges and Ferries	Low concentration (2.2 bridges per 100 km).
3. Transmission Lines	Moderate (1.7 transmission line crossings per 100 km).
4. Pipelines	Low (1.2 pipeline intersects per 100 km).
5. Population Concentration	Very low (0.07 people per km).
6. Population Centres	Little Smoky is only population centre.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	
3. Campgrounds	Low concentration (0.5 campgrounds per 100 km).
Historic Resource Sites	No known significant sites.
Protected Areas	Reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	Nearly 90% Crown land next to river.
2. Jurisdictions	2 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	IRP judged to be beneficial.

Milk River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low flow (256,000 acre-feet per year flowing into U.S.).
2. Water quality	Meets or exceeds all integrity guidelines.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Almost all agricultural land; grazing dominant activity.
3. Oil	River passes through some oil fields.
4. Gas	20% of river passes through gas fields.
5. Mining	Some coal fields present.
Industrial Water-Use	
Hydrological Developments	
1. Dams	Proposed dam; dam downstream in U.S.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Very minor linear development.
2. Bridges and Ferries	Low concentration (3 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Very low (0.5 pipeline intersects per 100 km).
5. Population Concentration	Very low (5 people per km).
6. Population Centres	Town of Milk River is only population centre.
Recreation and Tourism Development	
1. Provincial/National Parks	Writing-on-Stone Provincial Park
2. Recreation Area	Proposed Milk River-Lost River Wildland Recreation Area (AWA, 1990).
3. Campgrounds	Fairly low concentration (1 campground per 100 km).
Historic Resource Sites	More than 100 significant sites located in Writing-On-Stone Park.
Protected Areas	Provincial Park; proposed Natural River from secondary 880 to U.S. border (AWA, 1990); Milk River Natural Area.
Management Complications	
1. Land Tenure	44% privately owned and several sections leased for grazing.
2. Jurisdictions	4 municipalities.
3. Interprovincial/International	Upstream and downstream in U.S.
4. Integrated Resource Plans	No IRPs relevant to river.

North Saskatchewan River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Fairly high volume river (5,771,000 acre-feet per year at Saskatchewan border).
2. Water quality	Heavy industry and large municipal discharges in Edmonton/Fort Saskatchewan area; some sections do not meet water quality integrity guidelines; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	10% of river is in Sunpine Forest Management Agreement Areas.
2. Agriculture	About 50% of river passes through agricultural land.
3. Oil	40% of river passes through oil fields.
4. Gas	50% passes through gas fields; 7 gas plants near river.
5. Mining	1 coal mine and 2 salt mines are located near river; 10% passes through coal fields.
Industrial Water-Use	Very heavy use at Fort Saskatchewan.
Hydrological Developments	
1. Dams	Bighorn Dam; Brazeau Dam on tributary.
2. Generating Stations	1 hydro and 3 thermal generating stations.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	30% of river has roads or railways nearby.
2. Bridges and Ferries	Moderate concentration (nearly 5 bridges per 100 km); most are concentrated in Edmonton.
3. Transmission Lines	Very high.(8 transmission line crossings per 100 km).
4. Pipelines	Moderate (1.7 pipeline crossings per 100 km).
5. Population Concentration	Moderate (788 people per km); most in Edmonton.
6. Population Centres	Rocky Mountain House, Drayton Valley, Edmonton, Fort Saskatchewan.
Recreation and Tourism Development	
1. Provincial/National Parks	Provincial Park in Edmonton; Banff National Park.
2. Recreation Area	Bighorn Wildland Recreation Area; proposed Recreation River from Nordegg to Edmonton; Edmonton river valley system; at least 4 ski areas.
3. Campgrounds	Fairly low concentration (1.6 campgrounds per 100 km).
Historic Resource Sites	At least 30 significant sites have been located near this river.
Protected Areas	Banff National Park, Kootenay Plains Ecological Reserve, Provincial Park.
Management Complications	
1. Land Tenure	About 30% Crown land adjacent to river.
2. Jurisdictions	National Park, 12 municipalities, 2 cities, 2 Indian Reserves.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	IRPs relevant to river appear to be beneficial.

North Saskatchewan River (Segment 1 - Banff Park Boundary to Abraham Lake)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volume - 150 m^3/sec at Whirlpool Point (Travel Alberta, 1978).
2. Water quality	Excellent water quality at this point.
Industrial Land-Use	
1. Forestry	No current Forest Management Agreement Areas are located near this section.
2. Agriculture	
3. Oil	
4. Gas	
5. Mining	
Industrial Water-Use	
Hydrological Developments	
1. Dams	Bighorn Dam is downstream.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	This entire segment is paralleled by Hwy 11.
2. Bridges and Ferries	No major road crossings.
3. Transmission Lines	
4. Pipelines	
5. Population Concentration	Very low.
6. Population Centres	None.
Recreation and Tourism Development	
1. Provincial/National Parks	Banff National Park is located upstream of this segment.
2. Recreation Area	Bighorn Wildland Recreation Area.
3. Campgrounds	Very high concentration (11.5 campgrounds per 100 km).
Historic Resource Sites	At least 4 significant sites have been located along this section.
Protected Areas	Banff National Park protects headwaters; Kootenay Plains Ecological Reserve.
Management Complications	
1. Land Tenure	Nearly 100% of this section is surrounded by provincial Crown land.
2. Jurisdictions	1 municipality.
3. Interprovincial/International	
4. Integrated Resource Plans	David Thompson Corridor (A102) IRP.

North Saskatchewan River (Segment 2 - Bighorn Dam to Fort Saskatchewan)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volume - 250 m^3/sec. at Rocky Mountain House (Travel Alberta, 1978); regulated by Bighorn and Brazeau Dams.
2. Water quality	Fairly good - suitable for contact recreation; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	Nearly 1/3 of this segment passes through Forest Management Agreement Areas (Sunpine).
2. Agriculture	About half of this segment traverses agricultural land.
3. Oil	About half of this segment comes in contact with oil fields, including a major oil field near Rocky Mountain House.
4. Gas	Nearly half of this section passes through gas fields, including a major gas field near Drayton Valley; 4 gas plants nearby.
5. Mining	Passes through some significant coal producing areas with coal mine located near.
Industrial Water-Use	Moderate.
Hydrological Developments	
1. Dams	Bighorn Dam; Brazeau Dam on tributary.
2. Generating Stations	Bighorn hydro station; 2 thermal stations in Edmonton (Rossdale and Clover Bar).
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Railway line is adjacent to part of this segment between Nordegg and Rocky Mountain House; heavy linear development in Edmonton.
2. Bridges and Ferries	Fairly low concentration (5.2 bridges per 100 km); most in Edmonton.
3. Transmission Lines	
4. Pipelines	Fairly low (1.7 pipeline intersects per 100 km).
5. Population Concentration	High (300 people per km); most in Edmonton.
6. Population Centres	Rocky Mountain House, Drayton Valley, Devon, Edmonton.
Recreation and Tourism Development	
1. Provincial/National Parks	Provincial Park in Edmonton.
2. Recreation Area	Proposed recreation river between Nordegg and Edmonton (AWA, 1990); parks in Edmonton.
3. Campgrounds	Low concentration (0.8 campgrounds per 100 km).
Historic Resource Sites	At least 18 significant sites located along this segment.
Protected Areas	Provincial Park; Genesee Natural Area (AEP, 1993).
Management Complications	
1. Land Tenure	About 50% of land next to river is provincial Crown land.
2. Jurisdictions	1 Indian Reserve, 4 municipalities, 1 city.
3. Interprovincial/International	
4. Integrated Resource Plans	David Thompson Corridor (A102), Rocky - North Saskatchewan (A9) and Brazeau - Pembina (A8) IRPs.

North Saskatchewan River (Segment 3 - Fort Saskatchewan to Saskatchewan Border)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Fairly high volume (5,771,000 acre-feet per year at Saskatchewan border).
2. Water quality	Heavy industry and large municipal discharges in Edmonton/Fort Saskatchewan area; may not meet water quality integrity guidelines.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Surrounding land nearly 100% agricultural.
3. Oil	About 1/3 passes through major oil fields and oil sands; oil refineries.
4. Gas	About 80%of this segment contacts gas fields; 3 gas plants at Fort Saskatchewan.
5. Mining	2 salt mines located near this section of the river.
Industrial Water-Use	Heavy industry in Fort Saskatchewan.
Hydrological Developments	
1. Dams	
2. Generating Stations	Dow Chemical thermal station
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Only major linear development is near Fort Saskatchewan.
2. Bridges and Ferries	Fairly low concentration (3.3 crossings per 100 km).
3. Transmission Lines	
4. Pipelines	Low (1 pipeline intersect per 100 km).
5. Population Concentration	Fairly low (46 people per km).
6. Population Centres	Fort Saskatchewan, Duvernay, Heinsburg, Tulliby Lake.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Ski area near Fort Saskatchewan.
3. Campgrounds	Fairly low concentration (1.3 campgrounds per 100 km).
Historic Resource Sites	At least 8 significant sites - many related to the fur trade.
Protected Areas	2 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	Almost entirely private land.
2. Jurisdictions	1 city, 1 Indian Reserve, 8 municipalities.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	The Wandering River (C6) and Cold Lake (C9); plans are both in progress.

Oldman River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate water volume; heavy irrigation withdrawals; regulated by dam; subjected to periodic flooding.
2. Water quality	Meets most integrity guidelines for water quality; may not meet natural heritage integrity guidelines; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	
2. Agriculture	About 90% of surrounding land is agricultural.
3. Oil	Passes through some oil fields.
4. Gas	Some gas fields traversed.
5. Mining	About 20% of river passes through coal fields.
Industrial Water-Use	Some industrial use.
Hydrological Developments	
1. Dams	Oldman river dam; dams on tributaries.
2. Generating Stations	
3. Irrigation Use	Heavy irrigation use; at least 4 canals.
Urbanization/Development	
1. Roads/Railways	Linear development is low (12%).
2. Bridges and Ferries	Fairly low concentration (3.6 bridges per 100 km).
3. Transmission Lines	Fairly high (2.2 transmission lines per 100 km).
4. Pipelines	Fairly low (1.1 pipeline intersects per 100 km).
5. Population Concentration	Moderate (147 people/km).
6. Population Centres	Lethbridge is most important centre.
Recreation and Tourism Development	
1. Provincial/National Parks	Taber Provincial Park.
2. Recreation Area	Proposed Recreation River by AWA (headwaters to North Fork Bridge) and Whaleback Wildland Recreation Area; parks in Lethbridge.
3. Campgrounds	Moderate concentration (1.6 campgrounds per 100 km).
Historic Resource Sites	This river has a large number of significant sites.
Protected Areas	Proposed Natural River from Secondary Road 785 to MacLeod Island (AWA, 1990), Provincial Park, Beehive Natural Area.
Management Complications	
1. Land Tenure	25% Crown land next to river.
2. Jurisdictions	6 municipalities, 1 city, 2 Indian Reserves.
3. Interprovincial/International	Entire river is located in Alberta.
4. Integrated Resource Plans	IRPs appear to be very beneficial.

Oldman River (Segment 1 - Above Oldman Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low to moderate volumes of water (about 50 m^3/sec. at Waldron's Corner) (Travel Alberta, 1978).
2. Water quality	Generally good; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	
2. Agriculture	More than half of surrounding land is agricultural; ranching is dominant activity.
3. Oil	
4. Gas	
5. Mining	Upper reach is adjacent to potential coal development area.
Industrial Water-Use	
Hydrological Developments	
1. Dams	Oldman Dam is downstream.
2. Generating Stations	
3. Irrigation Use	Most irrigation is downstream of dam.
Urbanization/Development	
1. Roads/Railways	Roads follow the river for small portions of this segment.
2. Bridges and Ferries	Fairly low concentration (4.4 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Moderate (2.2 pipeline intersects per 100 km).
5. Population Concentration	Low.
6. Population Centres	None.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Proposed Recreation River and proposed Whaleback and Upper Oldman Wildland Recreation Area (AWA, 1990).
3. Campgrounds	High concentration (4.4 campgrounds per 100 km).
Historic Resource Sites	At least 5 significant sites have been recorded.
Protected Areas	Beehive Natural Area at headwaters.
Management Complications	
1. Land Tenure	About half of surrounding land is privately owned.
2. Jurisdictions	2 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	Livingstone - Porcupine Hills (EI) IRP.

Oldman River (Segment 2 - Below Oldman Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate water flow; heavy irrigation withdrawals; regulated by dam.
2. Water quality	May not meet natural integrity guidelines; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Nearly 100% of surrounding land is agricultural; heavy emphasis on irrigation farming.
3. Oil	This segment dissects a major oil field near the South Saskatchewan River.
4. Gas	Passes through some minor gas fields between Lethbridge and Taber.
5. Mining	3 potential coal development areas are adjacent to river.
Industrial Water-Use	Some industrial use.
Hydrological Developments	
1. Dams	Oldman Dam, LNID weir.
2. Generating Stations	
3. Irrigation Use	Very heavy irrigation use.
Urbanization/Development	
1. Roads/Railways	Only extensive linear development is near Lethbridge.
2. Bridges and Ferries	Fairly low concentration (3.3 crossings per 100 km).
3. Transmission Lines	
4. Pipelines	Low (1 pipeline intersect per 100 km).
5. Population Concentration	Moderate (230 people per km).
6. Population Centres	Brocket, Fort MacLeod, Monarch, Lethbridge, Diamond City.
Recreation and Tourism Development	
1. Provincial/National Parks	Taber Provincial Park.
2. Recreation Area	Recreation area below dam; parks in Lethbridge.
3. Campgrounds	Fairly low concentration (1.3 campgrounds per 100 km).
Historic Resource Sites	Very high density of significant sites (>40).
Protected Areas	Proposed Natural River (AWA, 1990); Taber Provincial Park; 3 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	Nearly all is private or leased land.
2. Jurisdictions	5 municipalities, 2 Indian Reserves, 1 city.
3. Interprovincial/International	
4. Integrated Resource Plans	None.

Peace River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Very high volume river (37,179,000 acre-feet per year at British Columbia border); regulated by WAC Bennett Dam.
2. Water quality	Pulp mill at Peace River; generally meets integrity guidelines for water quality.
Industrial Land-Use	
1. Forestry	18% of river passes through Forest Management Agreement Areas (Canadian Forest Products and Daishowa).
2. Agriculture	Half of river passes through agricultural lands.
3. Oil	10% of river passes through oil fields.
4. Gas	10% traverses gas fields; 1 gas plant nearby.
5. Mining	
Industrial Water-Use	1 pulp mill at Peace River, 1 pulp mill on tributary at Grande Prairie.
Hydrological Developments	
1. Dams	WAC Bennett Dam in British Columbia, proposed Dunvegan Dam.
2. Generating Stations	3 thermal stations.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Low contact with transportation routes.
2. Bridges and Ferries	Low concentration (less than 1 crossing per 100 km).
3. Transmission Lines	Low (0.5 transmission lines per 100 km).
4. Pipelines	Low (0.2 pipeline intersects per 100 km).
5. Population Concentration	Low (less than 10 people per km).
6. Population Centres	Peace River is largest centre.
Recreation and Tourism Development	
1. Provincial/National Parks	Notikewan Provincial Park, Wood Buffalo National Park.
2. Recreation Area	Several recreation sites between British Columbia border and Town of Peace River; proposed Recreation River from Cherry Point to Dunvegan.
3. Campgrounds	Low concentration (0.5 campgrounds per 100 km).
Historic Resource Sites	20 significant sites have been identified.
Protected Areas	Wood Buffalo National Park, Silver Valley Ecological Reserve, Provincial Park.
Management Complications	
1. Land Tenure	Nearly 90% Crown land.
2. Jurisdictions	1 National Park, 9 municipalities, 4 Indian Reserves, 1 Metis Settlement.
3. Interprovincial/International	37% of river is in British Columbia, impacted by WAC Bennett Dam.
4. Integrated Resource Plans	IRPs appear to be generally detrimental for river management.

Peace River (Segment 1 - British Columbia Border to Peace River Town)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Very high volume river (37,179,000 acre-feet per year at British Columbia border); regulated by WAC Bennett Dam.
2. Water quality	Generally good before Smoky River Confluence.
Industrial Land-Use	
1. Forestry	About 20% of this segment is bordered by a Canadian Forest Products Ltd. Forest Management Agreement Area.
2. Agriculture	Most of surrounding land is agricultural.
3. Oil	Some oil sands are located near river before Peace River Town.
4. Gas	This segment passes through several small gas fields, including one major gas field near Dunvegan.
5. Mining	
Industrial Water-Use	Low.
Hydrological Developments	
1. Dams	WAC Bennett Dam in British Columbia; proposed Dunvegan Dam.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Only a small proportion of this segment between Grimshaw Ferry and Peace River is paralleled by roads and railways.
2. Bridges and Ferries	Low concentration (1 crossing per 100 km).
3. Transmission Lines	
4. Pipelines	Fairly low (1.4 pipeline intersects per 100 km).
5. Population Concentration	Very low.
6. Population Centres	Dunvegan.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Several recreation areas (Mackenzie Cairn, Fort MacLeod Historical Park, Clear River, Campbell's Lease, Old Mill Site, Fourth Creek); proposed recreation river (AWA, 1990).
3. Campgrounds	High concentration (4.3 campgrounds per 100 km).
Historic Resource Sites	9 significant sites have been located along this segment.
Protected Areas	Silver Valley Ecological Reserve; 4 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	Mostly provincial Crown land with a large number of lease holders.
2. Jurisdictions	6 municipalities.
3. Interprovincial/International	Flows from British Columbia
4. Integrated Resource Plans	Upper Peace Valley (B101) and Smoky Peace Point (B103).

Peace River (Segment 2 - Peace River Town to Wood Buffalo Park Boundary)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Very high volume river (45,455,330 acre-feet per year at Peace River Town); regulated by WAC Bennett Dam.
2. Water quality	Pulp mills at Peace River and Grande Prairie have negative impact.
Industrial Land-Use	
1. Forestry	Large proportion of east side of this segment falls within Daishowa Forest Management Agreement Areas.
2. Agriculture	A significant proportion of this segment has been developed for agriculture.
3. Oil	This section passes through some oil sand deposits north of Peace River Town.
4. Gas	A major gas field is located near this segment.
5. Mining	
Industrial Water-Use	Pulp mills.
Hydrological Developments	
1. Dams	Impacted by WAC Bennett Dam.
2. Generating Stations	Fox Lake and Garden Creek thermal stations; Peace Point thermal station downstream in Wood Buffalo Park.
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Only a minimal proportion of this segment has parallel transportation route development.
2. Bridges and Ferries	Low concentration.
3. Transmission Lines	
4. Pipelines	Very low.
5. Population Concentration	Very low.
6. Population Centres	Peace River, Carcajou, Fort Vermillion, Fox Lake.
Recreation and Tourism Development	
1. Provincial/National Parks	Notikewan Provincial Park flows into Wood Buffalo National Park is downstream.
2. Recreation Area	
3. Campgrounds	Low concentration.
4. Historic Sites	11 significant sites have been identified.
Protected Areas	Notikewan Provincial Park, flows into Wood Buffalo National Park.
Management Complications	
1. Land Tenure	Mostly provincial Crown land (some leased).
2. Jurisdictions	3 municipalities, 4 Indian Reserves, 1 Métis Settlement.
3. Interprovincial/International	WAC Bennett Dam in British Columbia has impact.
4. Integrated Resource Plans	Lower Peace Valley (B102) and Jean D'Or Prairie (B4).

Red Deer River (Whole River)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volumes (1,493,000 acre-feet per year at Saskatchewan border); regulated by Dickson Dam.
2. Water quality	Most water quality integrity guidelines are met except for possibly natural heritage; mercury contamination of fish below Dickson Dam.
Industrial Land-Use	
1. Forestry	Sunpine Forest Management Agreement Area.
2. Agriculture	>80% of surrounding land is agricultural.
3. Oil	20% of river passes through oil fields.
4. Gas	70% passes through gas fields; 4 gas plants located near river.
5. Mining	1 coal mine, 24% of river passes through coal fields.
Industrial Water-Use	Some industrial use.
Hydrological Developments	
1. Dams	Dickson Dam; Diefenbaker Dam in Saskatchewan.
2. Generating Stations	Hydro station.
3. Irrigation Use	Moderate irrigation use.
Urbanization/Development	
1. Roads/Railways	Fairly low (14% of river has adjacent roads or railways).
2. Bridges and Ferries	Moderate concentration (4.4 crossings per 100 km).
3. Transmission Lines	High (3.4 transmission line crossings per 100 km).
4. Pipelines	Moderate (1.8 pipeline intersects per 100 km).
5. Population Concentration	Moderate (nearly 100 people per km).
6. Population Centres	Red Deer and Drumheller are the largest centres.
Recreation and Tourism Development	
1. Provincial/National Parks	Dry Island Buffalo Jump, Midland, Dinosaur, Banff.
2. Recreation Area	Bighorn Recreation Area, proposed Recreation River from Banff National Park to Sundre, parks in Red Deer and Drumheller.
3. Campgrounds	Moderate concentration (2.4 campgrounds per 100 km).
Historic Resource Sites	At least 12 significant sites have been recorded (all below Dickson Dam).
Protected Areas	Banff and Provincial Parks; proposed Natural River from Hwy. 36 to Saskatchewan border; proposed Little Fish Lake Conservation Natural Area; proposed Dune Point - Bindloss Ecological Reserve (AWA, 1990).
Management Complications	
1. Land Tenure	About 25% Crown land surrounding river.
2. Jurisdictions	National Park, 14 municipalities, 2 cities.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	Most IRPs relevant to river are still in planning stage.

Red Deer River (Segment 1 Banff Park Boundary to Glenifer Lake)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Fairly low volume river at this point (<100 m^3/sec. at Sundre).
2. Water quality	Good water quality above Dickson Dam.
Industrial Land-Use	
1. Forestry	About 1/3 of this segment flows through Sunpine Forest Management Agreement Area.
2. Agriculture	About half of this segment traverses agricultural lands.
3. Oil	This section flows through a major oil field near Sundre.
4. Gas	A large proportion (25%) of this section passes through gas fields.
5. Mining	
Industrial Water-Use	Low.
Hydrological Developments	
1. Dams	Dickson Dam is located downstream.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Most of the section that passes through the forest reserve is paralleled by a forestry trunk road.
2. Bridges and Ferries	Low concentration (2.0 bridges per 100 km).
3. Transmission Lines	
4. Pipelines	Moderate (2.7 pipeline intersects per 100 km).
5. Population Concentration	Fairly low (12 people per 100 km).
6. Population Centres	Sundre.
Recreation and Tourism Development	
1. Provincial/National Parks	Banff National Park is located upstream.
2. Recreation Area	Bighorn Wildland Recreation Area; proposed Recreation River (AWA, 1990).
3. Campgrounds	Moderate concentration (2.7 campgrounds per 100 km).
Historic Resource Sites	No significant sites have been found on this section.
Protected Areas	Headwaters protected in National Park; 2 reserved Natural Areas (AEP, 1993).
Management Complications	
1. Land Tenure	More than half of surrounding land is Crown.
2. Jurisdictions	5 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	Nordegg - Red Deer River (A10) is completed, while Red Deer River Corridor (D1) is still in progress.

Red Deer River (Segment 2 - Below Dickson Dam)

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volume (1,493,000 acre-feet per year at Saskatchewan border); flow regulated by Dickson Dam; some irrigation withdrawals.
2. Water quality	May not meet natural heritage integrity guidelines; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Surrounding land is almost entirely agricultural.
3. Oil	This section passes through a major oil field between Red Deer and Stettler.
4. Gas	Most of this section flows through gas fields, including a major gas field between Drumheller and the Saskatchewan border.
5. Mining	A large proportion (30%) of this segment traverses coal areas and 1 coal mine is located near the river.
Industrial Water-Use	Some.
Hydrological Developments	
1. Dams	Dickson Dam restricts flow; Diefenbaker Dam Downstream.
2. Generating Stations	Dickson Dam hydro station
3. Irrigation Use	Moderate irrigation use.
Urbanization/Development	
1. Roads/Railways	Only a minor proportion of this segment is developed, with the Red Deer and Drumheller areas the most significant; area near Empress is bordered by railway.
2. Bridges and Ferries	Moderate concentration (5.5 crossings per 100 km).
3. Transmission Lines	
4. Pipelines	Moderate (1.8 pipeline intersects per 100 km).
5. Population Concentration	
6. Population Centres	Red Deer, Nacine, Drumheller, Rosedale, East Coulee, Dorothy, Finnegan, Empress.
Recreation and Tourism Development	
1. Provincial/National Parks	Dry Island Buffalo Jump, Midland and Dinosaur Provincial Parks.
2. Recreation Area	Parks in Red Deer and Drumheller, ski areas.
3. Campgrounds	Moderate concentration (2.4 campgrounds per 100 km).
Historic Resource Sites	At least 12 significant sites have been recorded near river.
Protected Areas	Provincial Parks; proposed Little Fish Lake Conservation Natural Area, proposed Natural River from Hwy 36 to Saskatchewan border, proposed Dune Point - Bindloss Ecological Reserve (AWA, 1990); Nevis Natural Area (AEP, 1993).
Management Complications	
1. Land Tenure	Most of surrounding land is private, with some leaseholders.
2. Jurisdictions	2 cities, 8 municipalities, 2 special areas.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	Red Deer Corridor (D1) and Eastern Irrigation District (E3); plans are both in progress.

Sheep River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Low volume.
2. Water quality	Integrity guidelines generally met.
Industrial Land-Use	
1. Forestry	
2. Agriculture	50% of river traverses agricultural land.
3. Oil	Comes in contact with some oil fields.
4. Gas	20% of river traverses gas fields; 1 gas plant nearby.
5. Mining	
Industrial Water-Use	Low.
Hydrological Developments	
1. Dams	
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	20% paralleled by roads or railways.
2. Bridges and Ferries	Fairly low concentration (nearly 6 bridges per 100 km).
3. Transmission Lines	High (nearly 4 transmission line crossings per 100 km).
4. Pipelines	Moderate (nearly 3 pipeline intersects per 100 km).
5. Population Concentration	Moderate (almost 100 people per km).
6. Population Centres	Turner Valley, Black Diamond, Okotoks.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Kananaskis Country, proposed Elbow - Sheep Wildland Recreation Area (AWA, 1990).
3. Campgrounds	Fairly high concentration (about 4 campgrounds per 100 km).
Historic Resource Sites	5 significant sites have been located.
Protected Areas	
Management Complications	
1. Land Tenure	42% Crown land.
2. Jurisdictions	2 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	May be constraining to long term river management.

Slave River

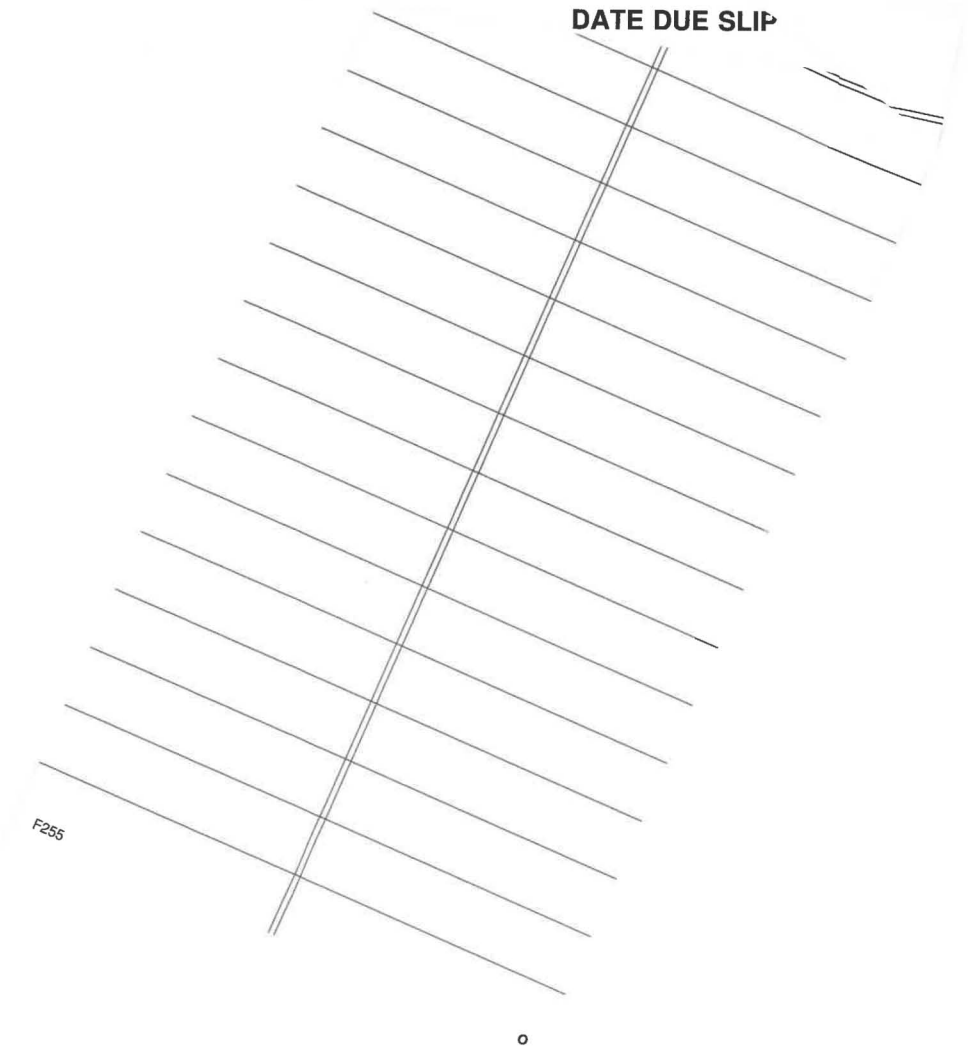
Management Issue	Description
Physical Characteristics	
1. Water quantity	Highest volume of water of any river in Alberta (89,162,000 acre-feet per year at Northwest Territories border).
2. Water quality	Natural heritage integrity guidelines may not be met; natural pollutants.
Industrial Land-Use	
1. Forestry	No Forestry Management Agreement Areas.
2. Agriculture	
3. Oil	
4. Gas	
5. Mining	
Industrial Water-Use	
Hydrological Developments	
1. Dams	WAC Bennett Dam on Peace River in British Columbia, proposed Dam in Northwest Territories.
2. Generating Stations	
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	Road parallels about half of river length in Alberta.
2. Bridges and Ferries	
3. Transmission Lines	
4. Pipelines	
5. Population Concentration	Very low concentration (0.2 people per km).
6. Population Centres	Fitzgerald.
Recreation and Tourism Development	
1. Provincial/National Parks	Wood Buffalo National Park.
2. Recreation Area	
3. Campgrounds	
Historic Resource Sites	3 significant sites have been recorded.
Protected Areas	Wood Buffalo National Park, proposed Natural River and proposed Pelican-Portage Ecological Reserve (AWA, 1990).
Management Complications	
1. Land Tenure	Nearly 100% Crown land.
2. Jurisdictions	1 National Park, 1 municipality.
3. Interprovincial/International	May be impacted by WAC Bennett Dam on Peace River in British Columbia, flows into North West Territories.
4. Integrated Resource Plans	No IRPs relevant to this river.

Smoky River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate water flow.
2. Water quality	Appears to meet most integrity guidelines; dioxin and furan contamination of fish.
Industrial Land-Use	
1. Forestry	36% of river traverses Forest Management Agreement Area (Weyerhaeuser).
2. Agriculture	32% of river passes through agricultural land.
3. Oil	Contacts some oil fields.
4. Gas	Passes through some gas fields.
5. Mining	1 coal mine, 5% traverses coal fields.
Industrial Water-Use	Pulp mill on tributary at Grande Prairie.
Hydrological Developments	
1. Dams	
2. Generating Stations	2 thermal plants (H.R. Milner and Karr).
3. Irrigation Use	
Urbanization/Development	
1. Roads/Railways	About 20% of river valley has adjacent roads or railways.
2. Bridges and Ferries	Low (1.6 bridges per 100 km).
3. Transmission Lines	Low (0.8 transmission line crossings per 100 km).
4. Pipelines	Low (1.0 pipeline intersects per 100 km).
5. Population Concentration	Light population concentration (8 people per km).
6. Population Centres	Only two population centres (Grande Cache and Watino).
Recreation and Tourism Development	
1. Provincial/National Parks	Jasper National Park.
2. Recreation Area	
3. Campgrounds	Fairly low concentration (1.4 campgrounds per 100 km).
Historic Resource Sites	Only 1 significant site has been recorded.
Protected Areas	Headwaters protected by Jasper National Park, Willmore Wilderness Park.
Management Complications	
1. Land Tenure	About 90% Crown land adjacent to river.
2. Jurisdictions	1 National Park, 6 municipalities.
3. Interprovincial/International	
4. Integrated Resource Plans	Somewhat constraining.

South Saskatchewan River

Management Issue	Description
Physical Characteristics	
1. Water quantity	Moderate volumes (4,769,000 acre-feet per year at Saskatchewan border); heavy irrigation withdrawals upstream.
2. Water quality	Natural integrity guidelines may not be met; mercury contamination of fish.
Industrial Land-Use	
1. Forestry	
2. Agriculture	Mostly agricultural land adjacent to river.
3. Oil	River traverses some oil fields.
4. Gas	Nearly 100% of river passes through a major gas field; 3 gas plants nearby.
5. Mining	Passes through some coal fields.
Industrial Water-Use	Some industrial use.
Hydrological Developments	
1. Dams	Impacted upstream by dams on Bow and Oldman Rivers and downstream by dam in Saskatchewan, proposed dam in Alberta.
2. Generating Stations	1 thermal station (Medicine Hat).
3. Irrigation Use	Moderate use; impacted by heavy irrigation use on Bow and Oldman Rivers.
Urbanization/Development	
1. Roads/Railways	Linear development is low (10%) along river.
2. Bridges and Ferries	Low concentration (about 2 bridges per 100 km).
3. Transmission Lines	Fairly low (1.4 transmission line crossings per 100 km).
4. Pipelines	Fairly low (more than 1 pipeline per 100 km).
5. Population Concentration	Moderate (166 people per km).
6. Population Centres	Medicine Hat and Red Cliff are only centres.
Recreation and Tourism Development	
1. Provincial/National Parks	
2. Recreation Area	Parks in Medicine Hat.
3. Campgrounds	Low concentration (0.7 campgrounds per 100 km).
Historic Resource Sites	At least 13 significant sites have been located.
Protected Areas	Middle Sand Hills National Wildlife Area; proposed Prairie Coulee Ecological Reserve.
Management Complications	
1. Land Tenure	Nearly 2/3 of river surrounded by Crown land, with a large proportion leased.
2. Jurisdictions	4 municipalities, 1 city, 1 Military Base.
3. Interprovincial/International	Flows into Saskatchewan.
4. Integrated Resource Plans	None.



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